ENVIRONMENTAL SCIENCE INTRODUCTION AND NATURAL RESOURCES

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 interrelation ships which exist among and between water, air and land and human beings and other living creatures such as plants, animals and micro organisms. She suggested that environment consists of an inseparable whole system constituted by physical, chemical, biological, social and cultural elements, which are interlinked individually and collectively in myriad ways. The natural environment consist 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 can be differentiated on the basis of temperature and each layer has its own characteristics. These 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. Biology is

concerned with how millions of species of animals, plants and other organisms grow, feed, move, reproduce and evolve over long periods of time in different environments. Its subject matter is useful to other sciences and professions that deal with life, such as agriculture, forestry and medicine. The richness of biosphere depends upon a number of factors like rainfall, temperature,

geographical reference etc. Apart from the physical environmental factors, the man made environment includes human groups, the material infrastructures built by man, the production relationships and institutional systems that he has devised. The social environment shows the way in which human societies have organized themselves and how they function in order to satisfy their needs.

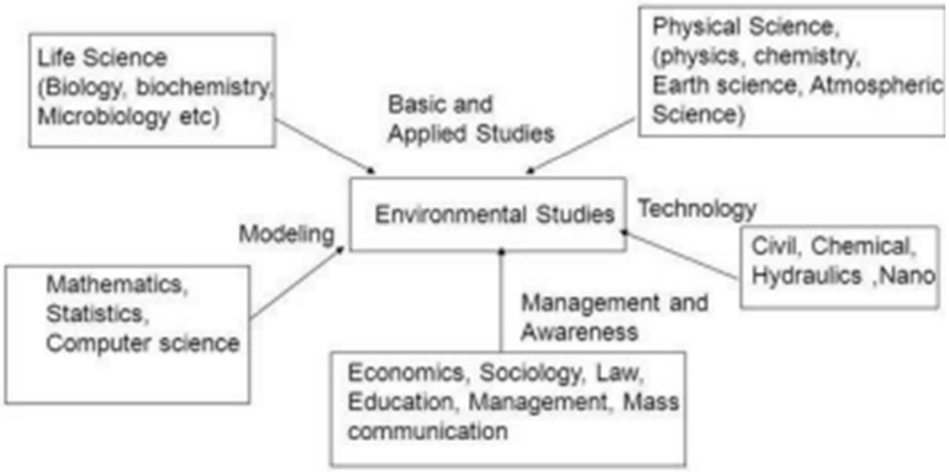
1.MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

1.1Environmental 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.

Related areas of study include environmental studies and environmental engineering. Environmental studies incorporate more of the social sciences for understanding human relationships, perceptions and policies towards the environment. Environmental engineering focuses on design and technology for improving environmental quality.

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



SCOPE OF ENVIRONMENTAL SCIENCE

Because of environmental studies has been seen to be multidisciplinary in nature so it is considered to be a subject with great scope. Environment is not limited to issues of sanitation and health but it is now concerned with pollution control, biodiversity conservation, waste management and conservation of natural resources. This requires expert eyes and hence is creating new job opportunities. The opportunities in this field are immense not only for scientists but also for engineers, biologists. There is a good chance of opportunity to find a job in this field as

environmental journalists. Environmental science can be applied in the following spheres:

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 components.

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 boobs, 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.

Research and development

Research and development have tremendous scope due to increment in public awareness regarding the environment. Various universities and governmental organizations offer a scope for such research. These universities conduct research studies in order to develop the methods toward monitoring and controlling the source of environmental pollution. Due to an increasing threat from global warming, many steps are being undertaken for the reduction of greenhouse gases and the adoption of renewable energy resources. They generate awareness now regarding the use of solar energy for variety of purposes. This provides scope of environmental history in the field of research and development.

Social Development

NGO (Nongovernmental organizations) help in creating awareness regarding the protection of the environment and making the masses aware of various environmental issues . They also generate a public opinion in this field. They work towards disseminating information and in bringing about changes in political policies that are personally effect the environment. The social dimension of this profession includes controlling population explosion through organizing advisory awareness camps.

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. When the West developed, it did so perhaps in ignorance of the Environmental impact of its activities. Evidently such a path is neither practicable nor desirable, even if developing world follows that.

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 by synchronized with the ecological cycles in any plan of development our actions should be planned ecologically for the sustenance of the environment and development.

1.2 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.

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.

2.1 Natural Resources and Associated Problems

Human population is growing day-by-day. Continuous increase in population caused an increasing demand for natural resources. Due to urban expansion, electricity need and industrialization, man started utilizing natural resources at a much larger scale. Non-renewable resources are limited. They cannot be replaced easily. After some time, these resources may come to an end. 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.

2.1.1 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_2 and release O_2which is required for sustaining the life on this earth. The poisonous gas CO_2 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.

MajorcausesofDeforestation:

a. **Shifting cultivation** : There are an estimated 300 million people living as shifting cultivators who practice slash and burn agriculture and are supported so clear more than 5 lakh ha of forests for shifting cultivation annually. In India, we have this practice of North-East and to some extent in Andhra Pradesh, Bihar and M.P. which contribute to nearly half of the forest clearing annually.

b. **Fuel requirements**: Increasing demands for fuel wood by the growing population in India alone has shooted 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 **MajoractivitiesandthreatstoForestsresources:**

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 than80000 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 are 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

CASE STUDIES:

Chipko movement related to mining or quarrying opposed by SundarlalBahuguna in North India. The first Chipko action took place spontaneously in April 1973 and over the next five years spread to many districts of the Himalaya in Uttar Pradesh. The name of the movement comes from a word meaning 'embrace': the villagers hug the trees, saving them by interposing their bodies between them and the contractors' axes. The Chipko protests in Uttar Pradesh achieved a major victory in 1980 with a 15-year ban on green felling in the Himalayan forests of that state by order of India's then Prime Minister, Indira Gandhi. Since then the movement has spread to Himachal Pradesh in the North, Kamataka in the South, and Rajasthan in the West, Bihar in the East and to the Vindhyas in Central India. In addition to the 15-year ban in Uttar Pradesh, the movement has stopped clear felling in the Western Ghats and the Vindhyas and generated pressure for a natural resource policy which is more sensitive to people's needs and ecological requirements.
Sardar Sarovar – Narmada project is a multipurpose project in Gujarat

2.1.2 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: Hydro electric 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 Indias 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 born of contention between tamilnadu and Karnataka and the problem is almost hundred years old. Tamilnadu occupying the downstream region of the river wants water-use regulated in the upstream state Karnataka refuses to do so and claims its privacy 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 Tamilnadus mettur dam every year, till a settlement was reached. In 1991-92 due to good monsoon, there was no disputr 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.

2.1.3 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 are 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

2.1.4 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.

WORLD FOOD PROBLEMS

Since world's population is growing every year and the demand of food is also increasing continuously. Although world's food production has increased almost three times during the last 50 years, but at the same time rapid population growth outstripped the food production. So, the world food problem is a complex one depending on food production, population increase, the prevalence of poverty and environmental impacts.
Famines are due to lack of access to food but not lack of food. Modern agriculture is largely based upon technological factors like the use of improved seeds, chemical fertilizers, synthetic pesticides etc…
The **green revolution** however changed traditional agricultural practices with a rapid increase in food production in developing countries. An American agricultural scientist, **Norman Borlaug** developed a high yielding variety of wheat through new concepts in plant breeding. By the mid 1960's, the green revolution was fully adopted in India.

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 increase 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.

2.1.5 ENERGY RESOURCES

Energy is defined by physicists as the capacity to do work. Energy is found on ourplanet 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 earths 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 (million 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_2 pollution leads to green house effect (global warming).

b) Crude oil***:*** It is obtained in the form of liquid . The crude oil is heated up to 600^{o}C in the oil refinery and condense the vapours of hydro – carbons. Petrol another petroleum products are

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 CO2 is less and thus reduces green house 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.

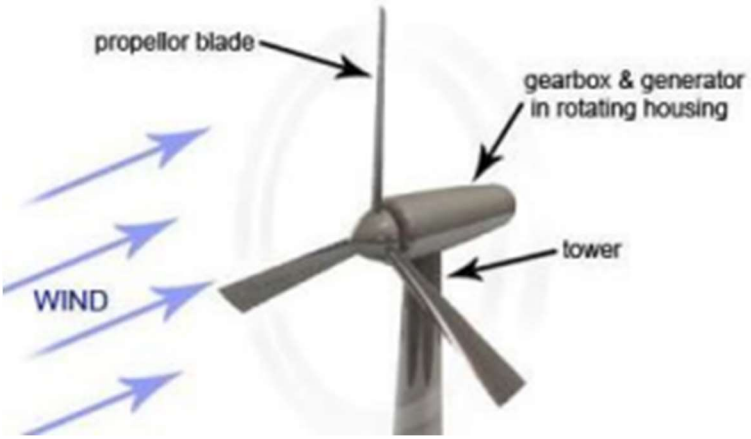
How Solar Power Works
The sun's energy can be captured to generate electricity or heat through a system of panels or mirrors.

- 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 about6000 MW is located in Tamil Nadu; 5000 MW in Gujarat and contribute thestates of Andhra Pradesh, Maharashtra, Uttar Pradesh and Rajasthan forbalance 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 areaswhere wind blows with required intensity.
5. Favorable in geographic locations which are away from cities.
6. Wind turbine design, manufacturing, installation is complex due tovarying 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 amixture of methane (68%), CO_2 (31%) and N_2 (1%). Methane gas (CH_4) 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_2 content.Bio-gas production is carried out in an enclosed bio-gas plant made of bricks or steel. Aslurry 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 = mc2).
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

CASE STUDIES

• In 1981, a plane called 'The Solar Challenger 'flew from Paris to England in 5hours, 20minutes. It had 16,000 solar cells glued to the wings and tail of the plane and they produced enough power to drive a small electric motor and propeller. Since 1987, every three years there is a World Solar challenge for solar operated vehicles in Australia where the vehicles cover 3000 kms.

• The world's first solar-powered hospitals in Mali in Africa. Being situated at the edge of the Sahara desert, Mali receives a large amount of sunlight. Panel's of solar cells supply the power needed to run vital equipment and keep medical supplies cool in refrigerators.

• In recent years, the popularity of building integrated photovoltaic's (BIPV's) has grown considerably. In this application, PV devices are designed as part of building materials (i.e. roofs and siding) both to produce electricity and reduce costs by replacing the costs of normal construction materials. There are more than 3, 000 BIPV systems in Germany and Japan has a program that will build 70,000BIPV buildings.

2.1.6 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; alkalinization 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.

2.2 ROLEOFANINDIVIDUALCONSERVATIONOFNATURALRESOURCES

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)ConserveWater:

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) Conserveenergy:

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 direr 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. ProtecttheSoil:

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.

PromoteSustainableAgriculture:

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

3.SYSTEM

ECOSYSTEM

An **ecosystem** is a community of organisms that interact with each other and non living components for sustainable development and adaptation to changing conditions. There are different type of ecosystems around us which involves living organisms and non living organisms. If we combine all the ecosystems present on earth, it is called **Biosphere**. The term ecosystem was first proposed by A.G.Tansley (1935) who defined ecosystem as follows: "Ecosystem is defined as a self-sustained community of plants and animals existing in its own environment."Odum (1971) defined ecosystem as any unit that includes all the organisms in a given area interacting with the physical environment, so that a flow of energy give rise to a clearly defined tropic structure, biotic diversity and material cycles within the system "Michael Allaby (1983) defined ecosystem as a community of interdependent organisms together with the environment

3.1 CONCEPT OF ECOSYSTEM:

In an ecosystem, the interaction of life with its environment takes place at many levels. A single bacteria in the soil interacts with water, air around it within a small space while a fish in a river interacts with water and other animals, rivals in a large space. .

Considering the operational point of view; the biotic and abiotic components of an ecosystem are so interlinked such that their separation from each other is practically difficult. So, in an ecosystem both organisms (biotic communities) and abiotic environment (rainfall, temperature, humidity) each influence the properties with other for maintenance of life.

3.2 STRUCTURE OF ECOSYSTEM

A structure of Ecosystem comprise of
•The Composition of biological community including, species number, biomass, life history, and distribution in space.
•The quantity and distribution of non-living material, such as nutrient water, etc. •The rage of condition of existence such as temperature, light.

FUNCTION OF ECOSYSTEM:

•The rate of biological energy flow i.e. production & respiration rates of the community. •The rate of material or nutrient cycles
•Biological or ecological regulation including both regulation of organism by environment and regulation of environment by the organisms.

3.3 COMPONENTS OF AN ECOSYSTEM:

There are two components of an ecosystem; Living components and non living components.

Non Living Components: (**Abiotic**) Non living components are the physical and chemical factors that directly or indirectly affect the living components e.g. air, water, land, rock etc. Non living components are also called **Abiotic** components.
Physical factors include sunlight, water, fire, soil, air, temperature etc.
Chemical factors include moisture, salinity of water, soil nutrients, oxygen dissolved in water etc.
Living Components: Living components in an ecosystem are either producers or consumers. They are also called **biotic** components. Producers can produce organic components e.g. plants can produce starch, carbohydrates, cellulose from a process called photosynthesis. Consumers are the components that are dependent on producers for their food e.g. human beings and animals•

Biotic Components are further classified into 3 main groups

•Producers •Consumers •Decomposers or Reducers

1. **Producer (Autotrophs):** The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compound namely, water and carbon dioxide. This process is known as photosynthesis. The chemical energy stored by the producers is utilized partly by the producers for their own growth and survival and the remaining is stored in the plants for their future use. They are classified into two categories based on their source of food.
   a)Photoautotrophs: An organism capable of synthesizing its own food from inorganic substances using light as an energy source. Green plants and photosynthetic bacteria are photoautotrophs.
   b)Chemotrophs: Organisms that obtain energy by the oxidation of electron donors in their environments. These molecules can be organic (chemoorganotrophs) or inorganic (chemolithotrophs).
2. **Consumers (Heterotrophs):** The animals lack chlorophyll and are unable to synthesis

their own food therefore they depend on the producers for their food. •They are known as heterotrophs (i.e. heteros= others, trophs= feeder).The Consumers are of 4 types:

(a) Primary Consumer: (Herbivores) i.e. Animal feeding on plants, e.g. Rabbit, deer, goat etc.

(b) Secondary Consumers: The animal feeding on Herbivores are called as secondary Consumer or primary carnivores. e.g. Cats, foxes, snakes.

(c) Tertiary Consumers: These are large carnivores which feed on secondary consumers. e.g. Wolves

(d) Quaternary Consumers: They are also called omnivores these are largest carnivores Which feed on tertiary consumers and are not eaten up by any other animals. e.g. lion and Tiger.

3. **Decomposers or Detrivores:** Bacteria & fungi belong to this category. They break down the dead organic matter of producers & consumers for their food and release to the environment the simple inorganic and organic substance. These simple substances are reused by the producers resulting in a cyclic exchange of material between biotic & abiotic environment.

Eg: Bacteria, Earth worms, Beetles etc

3.4 ENERGY FLOW IN AN ECOSYSTEM

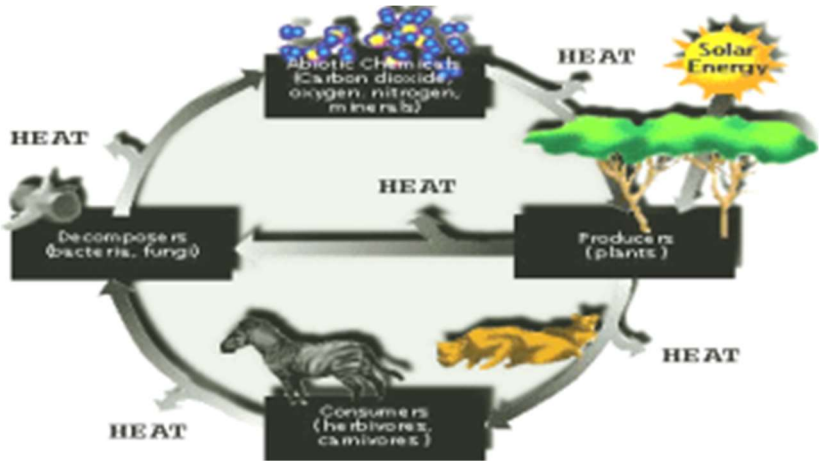
•Biological activities require energy which ultimately comes from the sun. Solar energy is transformed into chemical energy by a process of photosynthesis this energy is stored in plant tissue and then transformed into heat energy during metabolic activities.

•Thus in biological world the energy flows from the sun to plants and then to all heterotrophic organisms. The flow of energy is unidirectional and non-cyclic.

This one way flow of energy is governed by laws of thermodynamics which states that: (a) Energy can neither be created nor be destroyed but may be transformed from one form to another

(b) During the energy transfer there is degradation of energy from a concentrated form (mechanical, chemical, or electrical etc.) to a dispersed form (heat).

No energy transformation is 100 % efficient; it is always accompanied by some dispersion or loss of energy in the form heat. Therefore, biological systems including ecosystems must be supplied with energy on a continuous Basis.



MODELS OF ENERGY FLOW IN ECOSYSTEM

1. Single Channel Energy Flow Model: The flow of energy takes place in a unidirectional manner through a single channel of producers to herbivores and carnivores. The energy captured by autotrophs does not revert back to solar input but passes to herbivores; and that which passes to herbivores does not go back to autotrophs but passes to consumers. Due to one way flow of energy, the entire system would collapse if primary source of energy were cut off. At each tropic level there occurs progressive decrease in energy which is mainly due to loss of energy as heat in metabolic reactions and also some of the energy is utilized at each tropic level

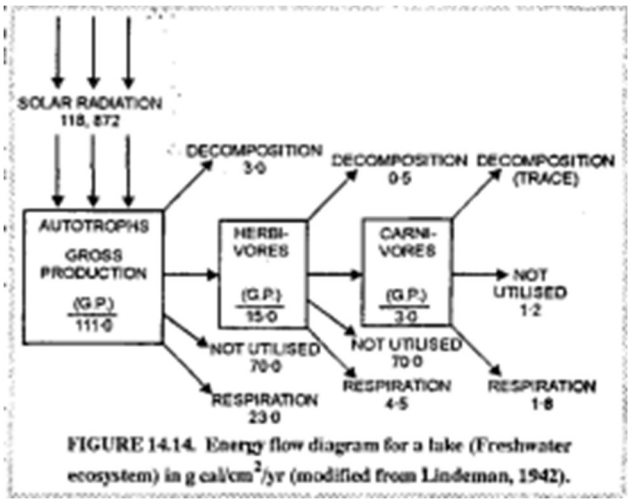


FIGURE 14.14. Energy flow diagram for a lake (Freshwater ecosystem) in g cal/cm^2/yr (modified from Lindeman, 1942).

2. Y- shaped model: shows a common boundary, light and heat flow as well as import, export and storage of organic matter . Decomposers are placed in separate box to partially separate the grazing and detritus food chains. In terms of energy levels decomposers are in fact a mixed group. •Y-shaped energy flow is more realistic and practical than the single channel energy flow model because: •It conforms to the basic stratified structure of ecosystems •It separates the two chains i.e. grazing & detritus food chain in both time and space. •Micro consumers (bacteria & fungi) and the macro consumers (animals) differ greatly in size- metabolism relations in two models.

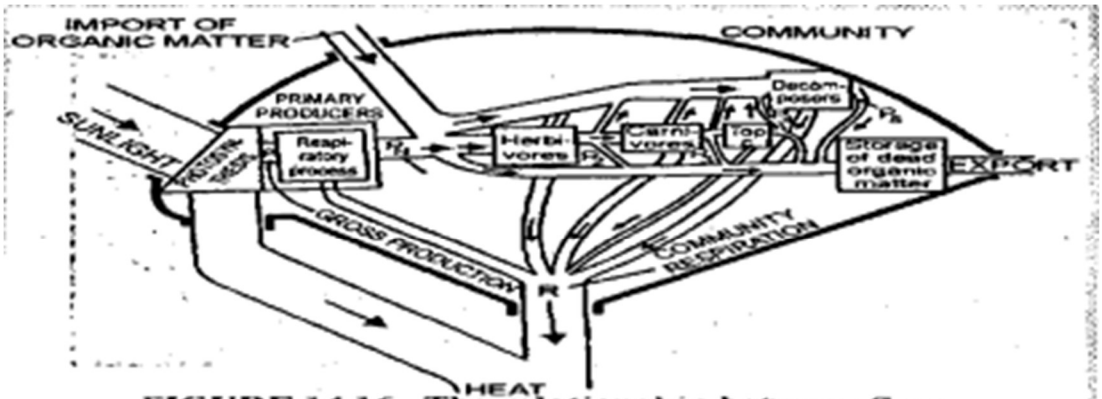


FIGURE 14.16. The relationship between flow of energy through the grazing food chain and detritus pathway (After H.T. Odum, 1956).

3.Universal energy flow model :As the flow of energy takes place, there is gradual loss of energy at each level there by resulting in less energy available at the next tropic level as indicated by narrower pipes (energy flow) and smaller boxes (stored energy in biomass). The loss of energy is mainly the energy which is not utilized (U). This is the energy loss in locomotion, excretion etc. or it the energy lost in respiration (CR) which is for maintenance. The remaining energy is used for production (P).

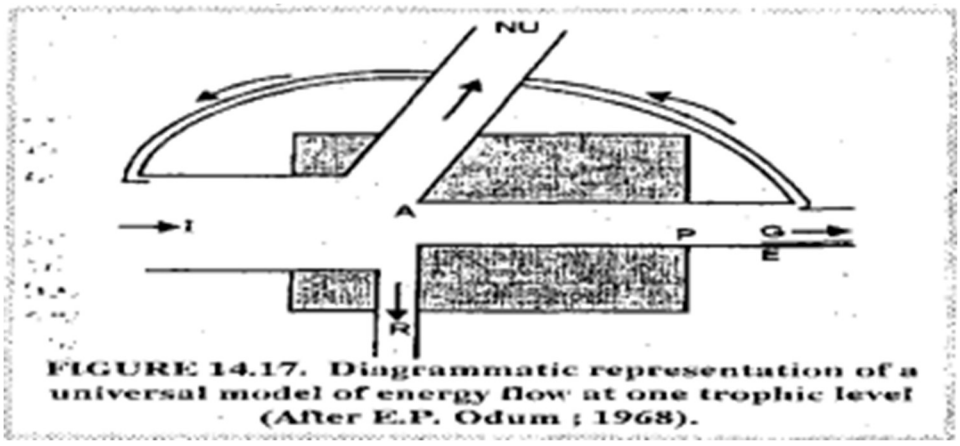


FIGURE 14.17. Diagrammatic representation of a universal model of energy flow at one trophic level (After E.P. Odum ; 1968).

3.5 ECOLOGICAL SUCCESSION

Ecological Succession is the phenomenon or process by which a community progressively transforms itself until a stable community is formed. It is a fundamental concept in ecology, refers to more or less predictable and orderly changes in the composition or structure of an ecological community. Succession may be initiated either by formation of new, unoccupied habitat (e.g., a lava flow or a severe landslide) or by some form of disturbance (e.g. fire, severe wind throw , logging) of an existing community. Succession that begins in areas where no soil is initially present is called primary succession, whereas succession that begins in areas where soil is already present is called secondary succession.

Clement's theory of succession/Mechanisms of succession

F.E. Clement (1916) developed a descriptive theory of succession and advanced it as a general ecological concept. His theory of succession had a powerful influence on ecological thought. Clement's concept is usually termed classical ecological theory. According to Clement, succession is a process involving several phases:

1. **Nudation**: Succession begins with the development of a bare site, called Nudation (disturbance).
2. **Migration**: It refers to arrival of propagules.
3. **Ecesis**: It involves establishment and initial growth of vegetation.
4. **Competition**: As vegetation became well established, grew, and spread, various species began to compete for space, light and nutrients. This phase is called competition. 5. **Reaction**: During this phase autogenic changes affect the habitat resulting in replacement of one plant community by another.
6. **Stabilization:** Reaction phase leads to development of a climax community.

Seral communities:

A seral community is an intermediate stage found in an ecosystem advancing towards its climax community. In many cases more than one seral stage evolves until climax conditions are attained. A prisere is a collection of seres making up the development of an area from non-vegetated surfaces to a climax community. Depending on the substratum and climate, a seral community can be one of the following:

Hydrosere : Community in freshwater
Lithosere : Community on rock
Psammosere : Community on sand
Xerosere : Community in dry area
Halosere : Community in saline body (e.g. a marsh)

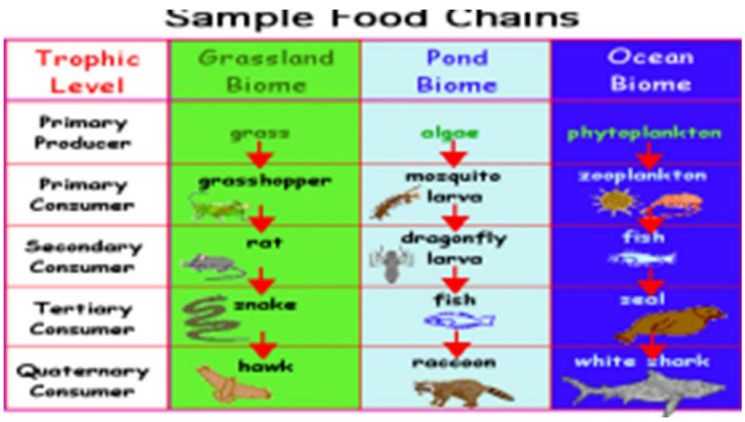
Climax community

The final or stable community in a sere is the climax community or climatic vegetation. It is self perpetuating and in equilibrium with the physical habitat. There is no net annual accumulation of organic matter in a climax community mostly. The annual production and use of energy is balanced in such a community.

3.6 FOOD CHAIN, FOOD WEB & ECOLOGICAL PYRAMIDS:

FOOD CHAIN:

In food chain each organism eats the smaller organisms and is eaten by the larger one. All those organisms which are interlinked with each other through food to gather constitute the ecosystem. •The different levels in a food chain are called tropic levels, Each food chain has three main tropic levels:- Producer level, Consumer level, and decomposer level. If any of the intermediate stage of the food chain is removed, the succeeding links of the food chain will be affected.



Types of Food Chains*:*

a) **Grazing Food Chain:** This type of food chain starts from living green plants goes to grazing herbivores and onto carnivores. Ecosystem with such type of food chain directly

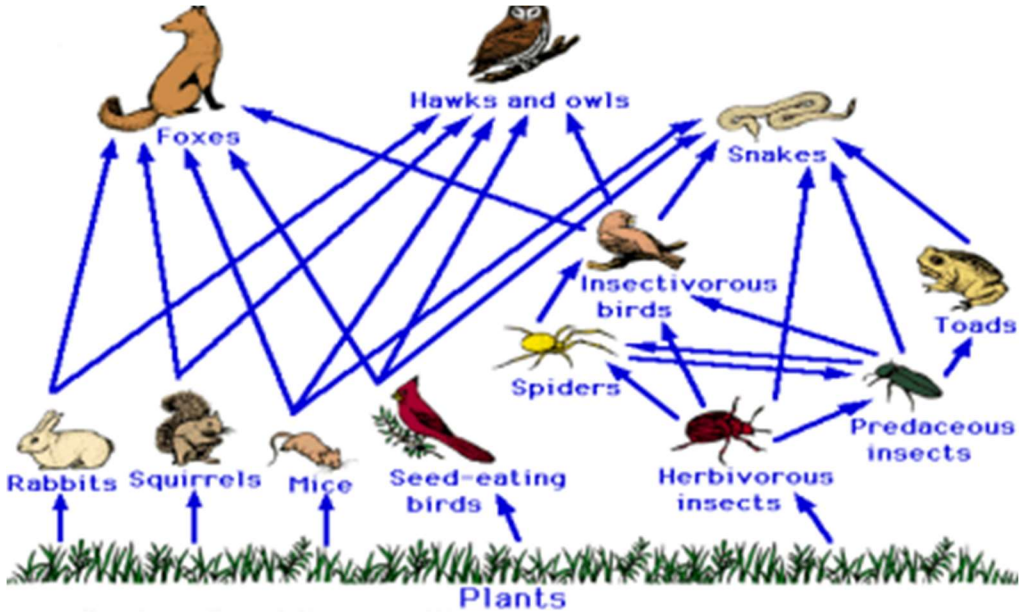
depends upon the solar energy for their food requirements. Most of the ecosystem in nature follows this type of food chain.

b) **Detritus food Chain:** This type of food chain goes from dead organic matter onto microorganisms and then to the organisms feeding on detritus and their predators. Such ecosystems are less dependent on direct solar energy.

c) **Parasitic Food Chain:** This type of food chain starts from big hosts and ends with parasitic organisms

FOOD WEB*:*

The interconnected, interlocking pattern of food chain is known as food web. •Under natural condition of the linear arrangement of food chain hardly occurs and they remain interconnected with each other through different types of organisms at different levels Such a interconnected and interlocking pattern of food chain is known as food web..



ECOLOGICAL PYRAMIDS

The different species in a food chain are called tropic levels. Each food chain has 3 main trophic level, producer, consumer, and decomposers. •Thus Graphical representation of these trophic levels is called as Ecological Pyramids. It was devised by an ecologist "**Charles Elton**" therefore this pyramid are also called Ecological pyramid or **Eltonian pyramids**.

Types of Ecological Pyramids:

Ecological pyramids are of three types: I

I) Pyramid of Number II)Pyramid of biomass
III)Pyramid of Energy

I) **Pyramid of Number**:

•They show the relationship between producers, herbivores, and carnivores at successive tropic levels in terms of their number.

•In case of pond ecosystem the producers are mainly phytoplankton and are always maximum in number this number then shows a decrease towards apex as primary consumers are zooplanktons are lesser in number than phytoplankton, the secondary consumers are large fish are even lesser in number than the phytoplankton. Thus the shape of pyramid is upright. But in case of forest ecosystem the pyramids is always inverted because the producers are mainly large trees, are lesser in numbers, the herbivores fruit eating birds are more in number than the producers, then there is gradual decrease in number of secondary consumers thus making pyramid upright again. Thus the pyramid of number does not give a true picture of the food chain and are not very functional.

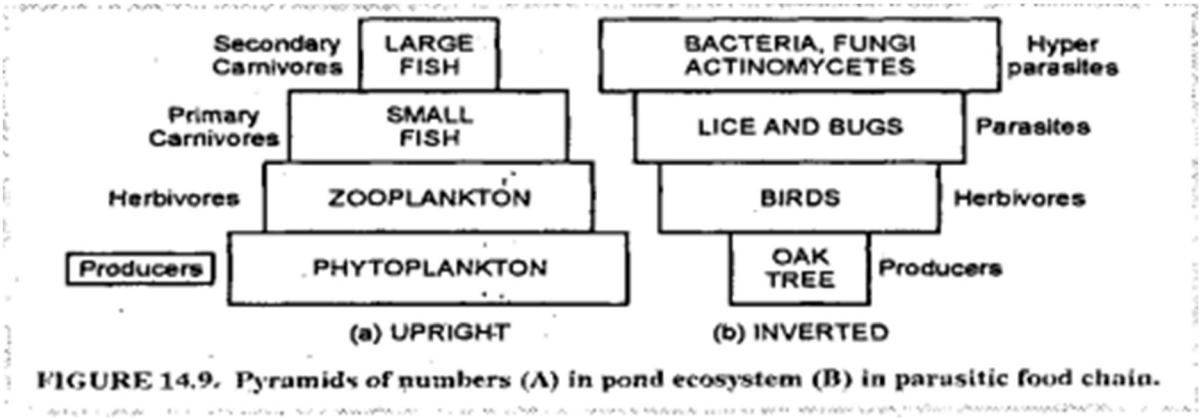


FIGURE 14.9. Pyramids of numbers (A) in pond ecosystem (B) in parasitic food chain.

II) **Pyramid of Biomass**:

•The pyramid of biomass represents the relationship between different tropic levels in terms of biomass. •There is generally gradual decrease in biomass of organisms at successive levels from the producers to the top carnivores. Thus pyramid of biomass is upright for grassland ecosystem. •However in case of a pond as the producers are algae, are least in number and this value gradually shows an increase towards the apex of pyramid thus making the pyramid inverted in shape.

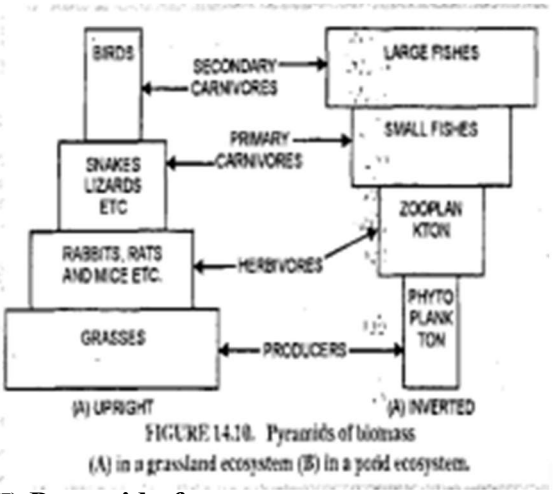
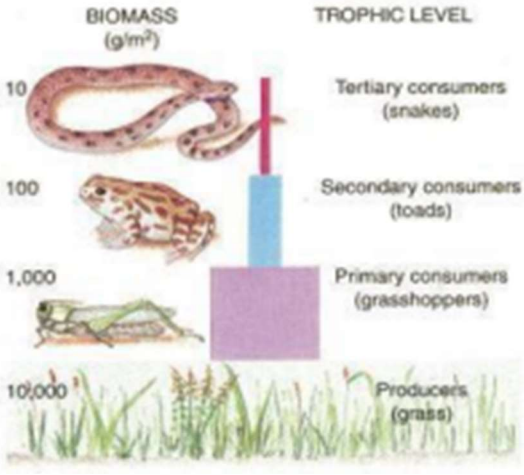


FIGURE 14.10. Pyramids of biomass (A) in a grassland ecosystem (B) in a pond ecosystem.



III) **Pyramid of energy**:

•Of the 3 types of ecological pyramid the energy pyramid gives the best picture of overall nature of the ecosystem. In this type of pyramid the tropic level is decided depending upon the rate at which food is being produced.

•In shape it is always upright as in most of the cases there is always gradual decrease in the energy content at successive trophic level from producers to various consumers.

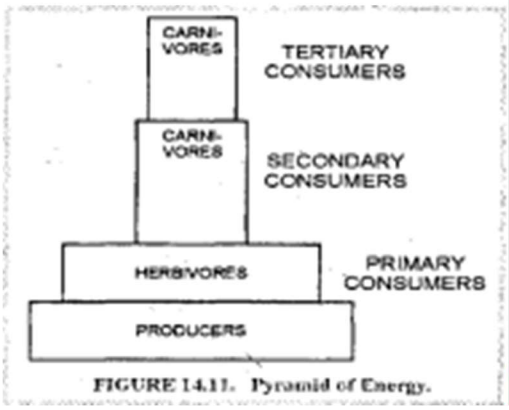


FIGURE 14.11. Pyramid of Energy.

CLASSIFICATION OF ECOSYSTEMS

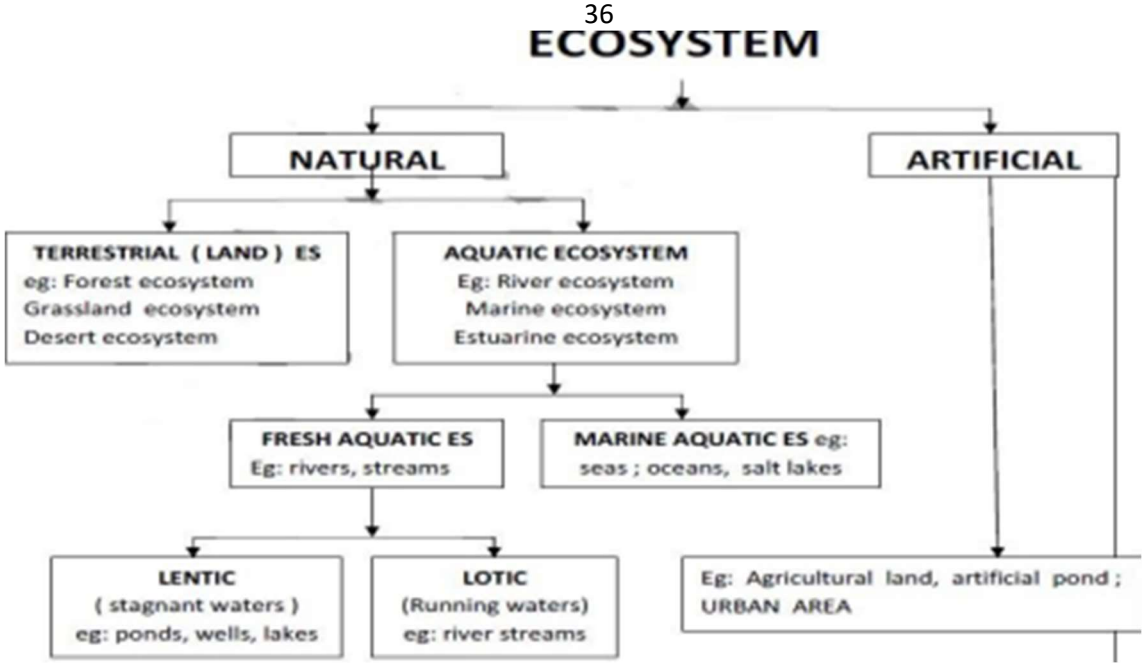
Due to the abiotic factors, different ecosystems develop in different ways. These factors and their interaction between each other and with biotic components have resulted in formation of different types of ecosystems as explained below.

Ecosystem may be natural or artificial.

Artificial Ecosystem: These are maintained or created artificially by man. The man tries to control biotic community as well as physico-chemical environment.

Eg: Artificial pond, urban area development.

Natural Ecosystem: It consists of Terrestrial and Aquatic Ecosystems which are maintained naturally.



Different types of ecosystem of biosphere artificially categorized as follows:

I) Natural Ecosystems: These ecosystems operate by themselves under natural conditions without any major interference by man. Based upon the particular kind of habitat, these are further divided as: •Terrestrial as forest, grassland, desert etc.

•Aquatic which may be further distinguished as

•Freshwater which may be lotic (running water as springs, stream, river) or lentic (standing water as

lake, pond, pools, ditch, swamps, etc.)

•Marine Ecosystems: as an ocean or shallow ones like sea or estuary etc.

II) Artificial Ecosystems: These are maintained by man where, by addition of energy & planned manipulations natural balance is disturbed regularly.

For eg : croplands like maize, wheat, rice-fields etc., where man tries to control the biotic community as well as physico-chemical environment are artificial ecosystems

3.9 Pond Ecosystem: A Pond as a whole serves a good example of freshwater ecosystem

•**Abiotic Components**: The chief components are heat, light, pH of water, CO2, oxygen, calcium, nitrogen, phosphates, etc.

•**Biotic Components**: The various organization that constitute the biotic component are as follows,

•**Producers:** These are green plants, and some photosynthetic bacteria. The producer fix radiant energy and convert it into organic substances as carbohydrates, protein etc •**Macrophytes:** these are large rooted plants, which include partly or completely submerged hydrophytes, eg Hydrilla, Trapha, Typha.

•**Phytoplankton:** These are minute floating or submerged lower plants eg algae.

•**Consumers:** They are heterotrophs which depend for their nutrition on the organic food manufactured by producers. •**Primary Consumers**: – **Benthos**: These are animals associated with living plants ,detrivores and some other microorganisms –**Zooplanktons:**

These are chiefly rotifers, protozoans, they feed on phytoplankton •**Secondary Consumers:** They are the Carnivores which feed on herbivores, these are chiefly insect and fish, most insects & water beetles, they feed on zooplanktons. •**Tertiary Consumers:** These are some large fish as game fish, turtles, which feed on small fish and thus become tertiary consumers. •**Decomposers:** They are also known as micro consumers. They decompose dead organic matter of both producers and animal to simple form. Thus they play an important role in the return of minerals again to the pond ecosystem, they are chiefly bacteria, & fungi.

Ocean Ecosystem

are more stable than pond ecosystem, they occupy 70 % of the earth surface. •**Abiotic Components:** Dissolved oxygen, light, temperature, minerals. •Biotic Components: •**Producers:** These are autotrophs and are also known Primary producers. They are mainly, some microscopic algae (phyto-planlanktons) besides them there are mainly, seaweeds, as brown and red algae also contribute to primary production. •**Consumers:** They are all heterotrophic macro consumers •**Primary Consumer:** The herbivores, that feed on producers are shrimps, Molluscs, fish, etc. •**Secondary Consumers:** These are carnivores fish as Herring, Shad, Mackerel, feeding on herbivores. •**Tertiary Consumers:** These includes, other carnivores fishes like, COD, Halibut, Sea Turtle, Sharks etc.
•**Decomposers:** The microbes active in the decay of dead organic matter of producers, and animals are chiefly, bacteria and some fungi.

Estuarine Ecosystem

•An estuary is a partially enclosed body of water along the coast where fresh water from river and streams meet and mix with salt water from oceans. These Ecosystems are considered as most

fertile ecosystem. •**Abiotic Components**: Nutrients such as phosphorus and nitrogen, temperature, light, salinity, pH. •This ecosystem experience wide daily and seasonal fluctuations in temperature and Salinity level because of variation in freshwater in flow. •**Biotic Components: •Producers: Phyplanktons**- these micro-organisms manufacture food by photosynthesis and absorb nutrients such as phosphorous and nitrogen, besides them, mangroves, sea grass, weeds, and salt marshes. •**Consumers: Primary consumers**, Zooplanktons that feed on Phytoplankton, besides them some small microorganisms that feed on producers. •**Secondary Consumer:** Include worms, shellfish, small fish, feeding on Zooplanktons •**Tertiary Consumer:** Fishes, turtles, crabs, starfishes feeding on secondary consumers. •**Decomposers:** Fungi & Bacteria are the chief microbes active in decay of dead organic matter.

River Ecosystem

•As Compared with lentic freshwater (Ponds & lakes), lotic waters such as streams, and river have been less studied. However, the various components of an riverine and stream ecosystem can be arranged as follows. •**Producers:** The chief producers that remain permanently attached to a firm substratum are green algae as Cladophora, and aquatic mosses. •**Consumers:** The consumers show certain features as permanent attachment to firm substrata, presence of hooks & suckers, sticky undersurface, streamline bodies, flattened bodies.. Thus a variety of animal are found, which are fresh spongy and caddis-fly larvae, snails, flat worms etc. •**Decomposers:** Various bacteria and fungi like actinomycetes are present which acts as decompose

4.BIODIVERSITY AND IT'S CONSERVATION

4.1 The word biodiversity is a combination of two words: "biological and diversity" and refers to thevariety of life on the Earth. **Biodiversity** is the degree of variation of life forms within a given species, ecosystem, biome, or an entire planet. Biodiversity is a measure of the health of ecosystems.
The term biological diversity was used first by wildlife scientist and conservationist Raymond F. Dasmann in the 1968.
The term's contracted form biodiversity may have been coined by W.G. Rosen in 1985

Biodiversity is usually considered at three different levels:
The following are different types of biodiversity

1. Genetic diversity: variety in the genetic makeup among individuals within a species 2. Species diversity: variety among the species or distinct types of living organisms found in different habitats of the planet
3. Ecosystem or ecological diversity: variety of forests, deserts, grasslands, streams, lakes, oceans, coral reefs, wetlands and other biological communities
4. Functional diversity: biological and chemical processes of functions such as energy flow an matter cycling needed for the survival of species and biological communities

1. Genetic Diversity: Genetic diversity is the "raw material" that permits species to adjust to a changing world whether these changes are due to natural factors or are caused by human factors. It refers to the variation at the level of individual genes and provides a mechanism for populations to adapt to their ever-changing environment.
Eg: Human beings

2. Species Diversity: Species diversity refers to the different types of living organisms on Earth. This includes the many types of birds, insects, plants, bacteria, fungi, mammals, and more. Many differing species often live together in communities depending on each other to provide their needs.
A species can be defined as a group or population of similar organisms that reproduce by interbreeding within the group. Members of a species do not normally reproduce with members of any other species. Members of a specific species possess common characteristics that distinguish them from other species and this remains constant regardless of geographic location.

3. Ecosystem Diversity: Ecological diversity or ecosystem diversity is the variety of biological communities, such as forests, deserts, grasslands and streams that interact with one another and with their physical and chemical (nonliving) environments. It relates to the different forms of life which are present in any one particular area or site, in more precise terms, it concerns the different

species of a particular genus which are present in an ecological community.

4.3 VALUES OF BIODIVERSITY

The value of biodiversity (in terms of its commercial utility, ecological services, social and aesthetic values) is enormous. There are several ways that biodiversity and its various forms are Valuable to humans. The biodiversity value may be classified as follows:

1. CONSUMPTIVE VALUE: Biodiversity is an essential requirement for the maintenance of global food supply. The main sources of human food include animals, fish and plant produces. A large number of plants are consumed by human beings as food. A few animal species are consumed by people which come from cattle, pigs, sheep, goats, buffaloes, chickens, ducks, geese and turkey species.

Fish: Many fresh water fish can be grown in ponds. Israel and China already get about half of their fish from aqua culture.

Drugs & medicines: About 75% of the world's population depends upon plants or plant extracts for medicines. The drug Penicillin used as an antibiotic is derived from a fungus called **Penicillium.** Likewise, Tetracycline from bacteria which is used to cure malaria is obtained from the bark of cinchona tree. .

Fuel: The fossil fuels like coal, petroleum products and natural gas are the products of biodiversity.

2. PRODUCTIVE VALUE: Some of the organisms are commercially usable where the product is marketed and sold. The animal products like tusks of elephants; musk from deer; silk from silkworm; wool from sheep or goats; fur of many animals etc all of which are traded in the market.

Eg: Calabar bean was tradionally used as a poison in West Africa.

Daisy plants were first used as a lice remedy in the Middle East and this led to the Discovery of Pyrethrum. Mosquito coils made from Pyrethrum are sold in the market. The bacterium Bacillus thuringiensis produces toxic proteins that kill certain insects.

3. SOCIAL VALUE: These are the values associated with the social life, religion and spiritual aspects of the people. Many of the plants are considered to be sacred in our country like Tulasi, Mango leaves, Banana leaves . The leaves, fruits, flowers of some of the plants are used in worship. Many animals like cow, snake, bull, peacock also have significant place in spiritual and thus hold special importance. Thus, biodiversity has distinct social value, attached with different societies.

4. ETHICAL VALUE: The ethical value means that human beings may or may not use a certain species but knowing the very fact that this species exists in nature gives pleasure. For eg: A peculiar species of Pigeon, grey / white bird with short legs is no more on this earth. Similarly, Dodo species is also no more. Human beings are not deriving anything direct from Kangaroo, giraffe but strongly feel that these species should exist in nature.

5. AESTHETIC VALUE: Every one of us would like to visit vast stretches of lands to enjoy the visible life. People from farther areas, spend a lot of time and money to visit wild life areas where they can enjoy the aesthetic value of biodiversity and this type of tourism is known as eco tourism. Eco-tourism is estimated to generate 12 billion dollars of revenue annually that roughly gives the aesthetic value of biodiversity.

A study of the impact of environment on the psyche was undertaken by Kaplan and Kaplan (1989) in which they found that being near nature relieved working stresses while people who worked in closed environment or human made structures experienced much more job stresses and illnesses.

4.4 BIODIVERSITY AT GLOBAL, NATIONAL AND LOCAL LEVEL

The enormous diversity of life forms in the biosphere has evolved essentially through the process of trial and error during course of organic evolution. The changes in character of living organism which confer some advantage to the species are retained.

The changes in climatic conditions are reflected in the distribution of living organism and the pattern of biodiversity on our planet. The number of species present per unit area decreases as we move from mild tropics to the tundra's.

The Indian region (8° to 30° N and 60° to 97.5°) with total area of 329 million hectares is very rich in biodiversity. It is estimated that about 4500 species of plants occur in this country. The position of Indian sub-continent at the confluence of there biogeography reels is also an important contributing factor and explain the preserve of African, European, Sind, Japanese and Indo-Malayan elements in the flora and fauna in India. It is the sum total of such remarkable

diversity that has made India a "gene bank" for a number of food crops, forest trees, medical and aromatic plants and domesticated animal.

Forests are important bioreserves; most of the 1700 million hectares of tropical forests are located in poor countries. The forests surrounding Reo de Aneroid are part of vegetation which is rich in species of plants and animals that are endemic. There are about 53.5% of trees species found only in these forests and studies of birds, reptiles, primates and butter flies have revealed equally high or higher endemics.

INDIA AS A MEGA DIVERSITY NATION

India contains a great wealth of biodiversity in the forests, wet lands and marine areas. Hence biodiversity can be observed at all levels ie locally, nationally and globally . India, as a subcontinent representing a major part of South Asia is rich in flora and fauna and hence it is one of the world's "MEGADIVERSITY NATIONS" .
It is estimated that over 75000 species of animals and over 45000 species of plants are found in India.

Biogeographic regions of India: According to **wild life Institute of India**, the country has 10 distinct biogeographic zones or regions. They are:

1. Trans – Himalayan Zone
2. Himalayan Zone
3. Desert Zone
4. Semi – arid Zone
5. Western Ghats
6. Deccan Zone
7. Gangetic plain Zone
8. NE Indian Zone
9. Coastal Zone
10. Islands around the country

HOTSPOTSOFBIODIVERSITY

Areas which exhibit high species richness as well as high species endemism are termed as hot spots of biodiversity. Species which are restricted only to particular areas are known as endemic. India shows a good number of endemic species. About 62% of amphibians and 50% of lizards are endemic to India. Western Ghats are the site of maximum endemism. The term "Hot spots" was introduced by **Myers** (1988). There are 25 such hot spots of biodiversity on a global level out of which two are present in India, namely the Eastern Himalayas and Western Ghats. These hotspots covering less than 2% of the world's land area are found to have about 50% of the terrestrial biodiversity. According to Myers an area is designated as a hotspot when it contains at least 0.5% of the plant species as endemics.

a) Eastern Himalayas: They display an ultra-varies topography that fosters species diversity and endemism. Recent studies have shown that North East India along with its contiguous regions of Burma and Chinese provinces of Yunnan and Schezwan is an active center of organic evolution and is considered to be the cradle of flowering plants. Out of the world's recorded flora 30% are endemic to India of which 35000 are in the Himalayas.

b) Western Ghats: It extends along a 17000 km² strip of forests in Maharashtra, Karnataka, Tamilnadu and Kerala and has 40% of the total endemic plant species. The major centers of diversity are Agastyamalai Hills and Silent valley- the new Amambalam Reserve Basin .It is reported that only 6.8% of the original forests are existing today while the rest has been deforested or degraded, which raises a serious cause of alarm, because it means we have already lost a huge proportion of the biodiversity.

4.5 THREATS TO BIODIVERSITY

Extinction or elimination of a species is a natural process of evolution. In the geologic period the earth has experienced mass extinctions. During evolution, species have died out and have been replaced by others. However, the rate of loss of species in geologic past has been a slow process, keeping in view the vast span of time going back to 444 million years. The process of extinction has become particularly fast in the recent years of civilization. Edward O. Wilson prefers the acronym HIPPO, standing for habitat destruction, invasive species, pollution, human overpopulation, and over-harvesting
Following are the major causes and issues related to threats to biodiversity:

1. Habitat destruction: Habitat destruction has played a key role in extinctions, especially related to tropical forest destruction. Factors contributing to habitat loss are: overpopulation, deforestation, pollution (air pollution, water pollution, soil contamination) and global warming or climate change. Habitat size and numbers of species are systematically related. Physically larger species and those living at lower latitudes or in forests or oceans are more sensitive to reduction in habitat area. Conversion to "trivial" standardized ecosystems (e.g., monoculture following deforestation) effectively destroys habitat for the more diverse species that preceded the conversion. In some countries lack of property rights or lax law/regulatory enforcement necessarily leads to biodiversity loss (degradation costs having to be supported by the community)

2. Poaching: Illegal trade of wildlife products by killing prohibited endangered animals i.e. poaching is another threat to wildlife. Despite international ban on trade in products from endangered species, smuggling of wildlife items like furs, hides, horns, tusks, live specimens and herbal products worth millions of dollars per year continues, the developing nations in Asia, Latin

America and Africa are the richest source of biodiversity and have enormous wealth of wildlife. The rich countries in Europe and North America and some affluent countries in Asia like Japan, Taiwan and Hong Kong are the major importers of the wildlife products or wildlife itself. The trading of such wild life products is highly profit making for the poachers who just hunt these prohibited wild lives and smuggle it to other countries mediated through mafia. The worst part is that for every live animal that actually gets into the market about 50 additional animals are caught and killed

If you are fond of rare plants, fish or birds, please make sure that you are not going to the endangered species or wild-caught species. Doing so will help in checking further decline of these species. Also do not purchase fur coat, purse or bag, or items made of crocodile skin or python skin. You will certainly help in preserving biodiversity by doing so.

3. Man-Wildlife Conflicts: We have discussed about the need to preserve and protect wildlife. However, sometimes we come across conflicting situations when wildlife starts causing immense damage and danger to man and under such conditions it becomes very difficult for the forest department to pacify the affected villages and gain local support for wildlife conservation. Instances of man animal conflicts keep on coming to lime light from several states in our country. In Sambalpur, Orissa 195 humans were killed in the last 5years by elephants. In retaliation the villagers killed 95 elephants in the border region of Kote-Chamarajanagar belt in Mysore have been reported recently. The man-elephant conflict in this region has arisen because of massive damage done by the elephants to the farmer's cotton and sugarcane crops. The agonized villagers electrocute the elephants and sometimes hide explosives in the sugarcane fields, which explode as the elephants intrude into their fields. In fact, more killings are done by locals than by poachers.

CausesofMan-animalconflicts:
Dwindling habitats of tigers, elephants, rhinos and bears due to shrinking forests cover are compelled to move outside the forests and attack the field or sometimes even humans. Human encroachment into the forest areas has rendered all forest living animals to trespass the borders of human civilizations. This is because the conflicts between man and the wildlife have increased since it is an issue of survival of both

Invasive Non-Native Species: Species that are non-native to a particular area can sometimes spread very quickly, for example the zebra mussel and Japanese knotweed have spread rapidly in Ireland in the past two decades. As a result, these species can destabilize an ecosystem by altering habitats affecting food webs.

Pollution/Litter: As you will remember from the Litter and Waste theme, pollution is always caused by humans. Pollution can have a huge impact, altering the balance within ecosystems, and is the cause of death for millions of animals and plants around the world every year.

Land Use Change/Increased Infrastructure Development: This is the alteration of natural areas by humans, for example, the clearing of huge areas of rainforest in South America for farming. In Ireland, upland open habitats, such as rough grassland, scrub and heath, have been changed by agriculture and afforestation.

Intensive Farming Practices: Extensive use and concentrations of chemical and/or biological pesticides and the removal of hedgerows are typical practices in modern-day intensive farming. Often large areas of land are planted with a single crop (monocultures) which greatly reduces the level of biodiversity in that area.

Climate Change: It is now widely accepted that the current global rate of change in climate is as a result of human activity. As global air or sea temperature changes, even by just 1 or 2 degrees, the habitats in which species live will also change and may even become uninhabitable to some species.

ENDANGERED AND ENDEMIC SPECIES

Endangered species A species whose numbers are reduced to the point. That means endangered species are in immediate danger of extinction.
The International Union Conservation of Nature (IUCN) classified the species of plants and animals as:
(a) Endangered species
(b) Threatened species: Species (including animals, plants, fungi, etc.) which are vulnerable to endangerment in the near future)
(c) Rare species : Among the important endangered animal species, Indian wild ass; the Kashmir stag, the Golden Langur etc .. are considered highly endangered. There are also endangered bird species like Siberian crane; the great Indian Bustard; the florican etc.. The IUCN published the data on endangered species of both plants and animals of India. The data symbolizes the working signal for those species which are endangered and if not protected are likely to become extinct in near future
A species is said to be **extinct** when it is not seen in the wild for 50 years at a stretch e.g. Dodo, Passenger Pigeon.
A species is said to be **endangered** when its number has been reduced to a critical level or whose habitat, have been drastically reduced and if such species is not protected and conserved, it is in immediate danger of extinction.

Endangered species of India

The International Union for Conservation of Nature and Natural Resources(IUCN) publishes the **Red Data Book** which include the list of endangered species of plants and animals. The red data symbolizes the warning signal for those species which are endangered and if not protected are likely to become extinct in near future

The animals that are listed under the critically endangered category are as under:

1)MalabarLargeSpottedCivet
2)NamdaphaFlyingSquirrel
3)SalimAli'sFruitBat
4)SumatranRhinoceros

EndangeredSpeciesareasunder:
1)AsiaticLion
2)AsiaticBlackBear
3)DesertCat
4)GreatIndianRhinoceros
5)IndianElephant(or)AsianElephant

ThreatenedSpeciesareasunder:
1)IndianWildAss
2)Leopard

Endemic species of India

India has two biodiversity hot-spots and thus possesses a large number of endemic species.

The endemic species are those taxa whose distribution is confined to a restricted area due to their specific ecological niches and edaphic gradients. Therefore, the habitats of endemic species are far more vulnerable than other species. Endemic species once lost, it is a loss of biodiversity of these species forever.

In India there are about 5725 endemic taxa of angiosperms (33.5% of Indian flora) which are located in 25 hot spots. The major hotspots in India which contain largest number of endemic plant species are the Southern Western Ghats and Eastern Himalayas with 1286 and 1808 endemic species respectively. There are about 1272 species of endemic angiosperms out of 3800 species occurring in Kerala (33.5% of Kerala flora) which represent 22.6% of Indian endemics. Seventy percent of the 1272 species of endemics have the major areas of distribution in Kerala with spill over in adjacent regions. On the basis of the study of the distributional range, about 102 endemic species occur exclusively in Kerala.

A large number out of a total of 81,000 of animals in our country is endemic. The Western Ghats are particularly rich in amphibians (frogs, toads etc) and reptiles (lizards, crocodiles etc) about 62% amphibians and 50% lizards are endemic to Western Ghats

.2.2.7 CONSERVATION OF BIODIVERSITY

In order to maintain and conserve biodiversity, the Ministry of Environment and Forests, government of India has already taken several steps to manage wildlife, the objectives of which are:
1. Maintenance of a number of species in protected areas such as National Parks, Sanctuaries.. 2. To improve the biosphere reserves
3. Implement strict restrictions of export of rare plants and animals
4. Educate the public on these through the government agencies and NGO's.

A) In-situ conservation: The preservation of species **in its natural ecosystem** is called in-situ conservation. As a consequence, protected areas are being identified and maintained for natural conservation of species by individual countries. For the conservation and management of endangered species several projects have been established.
These are:

Tiger Projects: Corbett National Park which is 300 km from New Delhi is the oldest National Park of India having 1318.54 sq km. It was one of the nine Tiger Reserves created at the launch of the Project Tiger in 1973.

Gir Lion Projects: The Gir Forest of Gujarat where lions are found. This has an area of 1412 sq kms and declared as a National Park.

Elephant Projects: The objective was to ensure long-term survival of population of elephants (not come into operations). Project Elephant (PE), a centrally sponsored scheme, was launched in February 1992 to provide financial and technical support to major elephant bearing States in the country for protection of elephants and their habitats. The Project is being implemented in 13 States/UTs, viz..Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Karnataka, Kerala, Meghalaya, Nagaland, Orissa, Tamil Nadu, Uttaranchal, Uttar Pradesh and West Bengal. There are about 7000 protected areas in the world which include a variety of National parks, Sanctuaries etc which vary in size (between 100 to 500 sq km), purpose (protection of one or more species and their habitats).. In India, there are 39 National Parks and 492 wildlife sanctuaries.

National Parks: These are protected areas exclusively for wild life. Human activities like hunting, Firewood collection, timber harvesting etc… are restricted in these areas to that wild plants and animals could grow in a protected environment

The following measures should be adopted for the conservation of biodiversity: 1. Over grazing in the forest and areas of vegetation should be controlled because it may Destroy the useful rare plants.
2. The habitat of plants and animals should be conserved.
3. The natural condition of ecosystem should be studied and researched in time and again, then Specific programs for conservation should be conducted.
4. Human activities should be done without destroying natural environment. 5. Illegal

hunting and smuggling of animals and plants should be strictly avoided. 6. Effective laws and rules should be adopted for the conservation of rare animals and plants. 7. Industries are established from the raw materials. During the process of collecting raw materials, care should be taken not to destroy useful plants and habitats of animals. 8. Public awareness should be created about the importance of rare animals and plants, causes of rareness and measures for their preservation.

B) Ex-situ conservation: The conservation of elements of biodiversity out of the context of their natural habitats is referred to as ex-situ conservation. Zoos, botanical gardens and seed banks are all example of ex-situ conservation. In India we have the following important gene and seed bank facilities.

i) National Bureau of Plant Genetic Resources (NBPGR) is located in New Delhi. Here agricultural and horticultural crops are stored by **cryopreservation** of seeds, pollens etc. by using liquid nitrogen at a low temperature as low as -196^0C.

ii) National Bureau of Animal Genetic Resources (NBAGR) located at karnal, Haryana. It preserves the semen of domesticated bovine animals.

5.ENVIRONMENTAL POLLUTION

ENVIRONMENTAL POLLUTION 5...1

INTRODUCTION:

According to **ODUM (1971)**, Pollution is **"an undesirable change in the characteristics of air, water and land that harmfully affect the life and also create health hazards for all living organisms on the globe"**.
According to **SOUTHWICK (1976),** Pollution can be defined as **"the unfavorable (or) alteration of environment caused by human activities and causing harm to human beings".**

TYPES OF POLLUTION:

Basically the Pollution is of two types viz.,

(1) Natural Pollution: This type of pollution is limited in its occurrence generally from natural hazards like volcanic eruptions, emissions of natural gas, soil erosion, ultraviolet rays, cosmic rays etc and
(2) Manmade Pollution: Most of the pollution is man made only. However, Pollution is usually categorized as Air Pollution; Water Pollution; Thermal Pollution; Noise Pollution; Land & soil Pollution; Radio Active Pollution and Marine Pollution

5.1.1AIR POLLUTION

Air pollution may be described as "**the imbalance in quality of air so as to cause adverse effects on the living organisms existing on earth**". Pollution is due to the presence of undesirable substance of sufficient quantity which exists in environment.
The substance or energy which causes pollution is called pollutant.

Types of air pollutants:
Pollutants may be classified according to origin and state of matter.

a) According to Origin: Air pollutants are divided into two categories as primary & secondary. 1) Primary air pollutants are those which are emitted directly into the atmosphere.

Eg: C; CO; CO_2; SOx ; N; S; H; NOx; CFC's etc .

2) Secondary air pollutants are those which are produced in the air by the interaction Among the primary air pollutants or by reaction with atmospheric constituents. Eg: **Ozone (O_3)**; **Smog; Para Acetyl Nitrate (PAN)**; **Acid Rain**; **Aerosols.**

b) According to State of Matter: Air pollutants include fine solids; liquids and gases. Dust, Smoke, Fumes etc are examples for solid particles whereas fog is an example for liquid particles.

PRIMARY POLLUTANTS

1. Carbon Monoxide: It is a colorless, odorless, poisonous gas that is produced by the incomplete burning of carbon based fuels (coal, petrol, diesel and wood) which comes from the automobile industries, exhaust devices, About 70% of CO emissions are from the transport sector.
When the air is polluted with CO, human blood is likely to be deprived of oxygen and leads to coma and death. In mild dosages, it leads to headache.

2. Oxides of Sulphur: SO_2 is a gas produced from burning of coal, mainly in thermal power plants. Some industries such as paper mills produce SO_2. It is injurious not only to men and plants, but it also attacks rapidly a few rocks such as limestone, marbles, electric contacts etc. It can even dissolve nylon.
Paper absorbs SO_2 causing the paper to become brittle and fragile. SO_2 polluted air leads to corrosion of metals such as Fe, Zn, Cu, steel etc… SO_2 is a major contributor to Smog and acid rain.
Sulphur trioxideis more irritant than SO_2 because it combines immediately with water to form sulphuric acid.

3. Oxides of Nitrogen: Combustion of coal, oil, natural gas and gasoline which produces upto 50 ppm of Nitrogen. NOx are also produced when fossil fuels are burned especially in power plants and motor vehicles. NO_2poisoning results SILOFILTER disease. High levels of NO_2 exposure causes cough and make the human beings feel short of breath. People who are exposed to NO_2 for a long time have a higher chance of getting respiratory infections.
NOx compounds contribute for the formation of Ozone. Similarly, when nitrogen oxide when combine with SOx to form acid rain.

4. Chloro Fluoro Carbons: CFC's (also known as Freon) are non- toxic. They contain Carbon, Fluorine and Chlorine atoms.The five main CFCs are the following:

CFC – 11 (Trichloro Fluoro Methane $CFCl_3$)

CFC – 12 (Dichloro Fluoro Methane CF_2Cl_2)

The major uses of CFCs are as coolants in refrigerators and in air conditioners; as solvents in cleaners particularly for electronic circuit boards etc.. CFCs are the main cause of ozone depletion. CFCs have a lifetime in the atmosphere of about 20 to 100 years, and as a result one free chlorine atom from a CFC molecule can do a lot of damage.

SECONDARY POLLUTANTS:
1) Ozone (O_3) / Ozone layer Depletion: Ozone consists of oxygen molecules which contain three oxygen atoms. It is not emitted directly into the air but produced in the atmosphere when oxygen combines with oxygen radical (**O**·) in the presence of sunlight. Ozone protects us from ultra violet radiation and other harmful rays.
It is observed that over the last few years, many manmade processes release gases into atmosphere causing drastic depletion of ozone layer. The chlorine atoms cause depletion of ozone slowly and holes are formed in the ozone layer.
Ozone reacts with tissues and cause for breathing and decrease the working ability of the lungs, chest pains and coughing. It lowers the human body resistance power and leads to cold; pneumonia also.

Antarctic Ozone depletion: According to NIMBUS-7 satellite picture which was taken on 5th October, 1987 the protective ozone layer showed a hole over 50% of the area of the Antarctica continent covering 7 million sq km.

On Jan 1st 1989, the country Montreal (Canada) proposed redesigning refrigeration, air conditioning technology replacing the use of CFCs by ozone friendly substitutes.

2) Smog: Smog is a combination of smoke and fog or various gases when react in the presence of sunlight. The effects of smog on human health cause for respiratory, irritation to the eyes, diseases related to nose, throat, bronchitis, pneumonia, headache, nerves, liver, and kidneys. The first smog related deaths were recorded in London in 1873, when it killed 500 people. In 1892, December, London had worst experiences causing 1000 deaths. In 1940's severe smog began covering the cities of Los Angeles in USA.

3) Acid rain: Acid rain has become one of the most important global environmental problems and poses significant adverse impact on soils, rivers, lakes, forests and monuments. The phenomenon occurs when SOx and NOx from the burning of fossil fuels such as Petrol, Diesel, Coat etc combine with water vapour in atmosphere and fall as rain or snow or fog.
Natural sources like volcanoes, forest fires, etc also contribute SOx and NOx. Increased urban and industrial activities cause air pollution resulting in the rise of concentration of SO_2 and NOx. Sulphur dioxide and NO_2 combines with water vapour in the atmosphere produce sulphuric acid and Nitric acid respectively and results acid rain. Some of the examples are:
Europe and parts of W Asia have experienced rain with water pH range of 4.5 to 5.0 (acidic) in 1958.

AIR POLLUTION EFFECTS, PREVENTION AND CONTROL MEASURES: Human beings breathe 22000 times a day on the average, inhaling 16 kg of air. Atmosphere constitutes a protective cover of gases surrounding the earth which
sustains life and saves it from unfriendly environment.
The atmosphere consists of several layers viz. Troposphere, Stratosphere; Mesosphere; Thermosphere & Exosphere.
The lower atmosphere i.e., the troposphere contains 70% of gaseous components of major, minor and traces. Ultra violet radiation from the sun is absorbed by ozone in the stratosphere which is so called ozone layer located between 17 - 26 kms above sea level.

Effects of Air pollution: The effects of pollution may be direct and affect certain organisms. The effects of pollution may possess a hazard or nuisance. Long continued pollution even affects the evolution of a species and eliminates organisms that cannot tolerate certain pollutants and favor others who can eat.
Air pollution causes deaths, Impair health, reduce visibility and brings vast economic losses. It can also cause intangible losses to historic monuments such as Taj Mahal. Finally, Air pollution can affect the environment on a global scale.

Prevention and control of Air Pollution:

- Inputs that do not contain the pollutants.
- Operating process to minimize generation of the pollutants.
- Replacing the process with one does not generate the pollutant.
- Removing the pollutants from the process.
- Substitution of raw materials.

Eg: The substitution of high sulphur coal with low sulphur coal in power plants. Eg: Changing a fossil fuel with nuclear energy can eliminate sulphur emission. By involving the Process Modification:

Eg: Chemical and petroleum industries have changed by implementing Automated operations, computerized process control by reducing the Oxidation of SO_2 to SO_3 by reducing excess air.

 By involving the control technologies: Control equipment viz., Wet Collector (scrubber), Gravity Settling chamber; Cyclone Collectors, Dry Scrubbers, filters, electrostatic precipitators etc. are to be used to minimize the air pollution.

5.1.2 WATER POLLUTION

Hydrosphere in the universe contains water in the form of oceans, rivers, lakes, tanks and many other water sources.
Water sources in the world are of two types.
They are (1) Marine water bodies and (2) Fresh Water bodies.
Water is a good solvent for many substances. Because of this property water cannot exist in its pure form at many parts of the world. Water pollution is mainly because of sewage, industrial disposals i.e., effluents.

PARAMETERS OF WATER POLLUTION:
Chemical examination of water (tests): pH; Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), etc are some of the chemical tests to find the stage of pollution of water.

1. pH: The value of pH gives the degree of acidity or alkalinity of polluted water. Determination of pH is important in calculating the coagulant (thick or thin) dose.

2. Biological Oxygen Demand (BOD): It is defined as the quantity of oxygen utilized by micro organisms at a temperature of 20°C, generally measured for 5 days. When water is polluted by unwanted materials, naturally the O_2 content gets reduced and that water become not fit for consumption either by human beings or animals or plants.
Living organisms require water with some quantity of sustainable oxygen in it. That oxygen is necessary for living organisms is generally called BOD. If there is reduction in oxygen content of water, it becomes unfit for biological consumption because there is change in BOD.

COMMON TYPES OF WATER POLLUTANTS:
A) Based on sources B) Based on natures

A) Based on sources:
a) Disease causing agents: Bacteria, viruses, protozoan that enter water from domestic sewage and animal wastes.
b) Water soluble inorganic chemicals: Acids, salts and compounds of toxic metals such as Lead, Mercury can make water unfit to drink, harm fishes and other aquatic life. Also Nitrate, Phosphate compounds dissolve in water that can cause excessive growth of algae, which then die and decay, depleting dissolved O_2 in water and killing fish.

c) Water Soluble Organic chemicals: Oil, gasoline (a type of oil is obtained from petroleum), pesticides, detergents and many other water soluble chemicals that threaten human health and harm fish.
d) Heat: Large quantity of water is heated when it is used in the cooling towers of thermal power plants. When this hot water is discharged into the nearby water bodies, it causes an increase in its temperature.
e) Sewage: sewage is waste water from municipal area where there is human habitation. Sewage which comes from homes is called **domestic sewage**

B) Based on natures:
In nature water pollution is classified into three types by **Kimball** (1975). They are: **1. Domestic water pollution:** Sewage is a part of domestic water pollution. Domestic sewage not only contains unwanted waste materials, but it is also infested with harmful bacteria, virus etc. These are responsible for causing diseases in animals and human beings, if they drink this polluted water and even plants may die if polluted water is provided. Domestic water pollution leads to Diarrhea, Cholera and Typhoid in human beings.

2. Agricultural Water Pollution: Water require for plants for its growth. Major irrigation, minor irrigation, sprinkler irrigation, drip irrigation, lift irrigation carry waste substances and causing water pollution in addition to the utilization of fertilizer and pesticides. Agricultural water pollution leads to Eutrophication & Water Bloom.

Ecological effects: The important troubling ecological impacts are:

1. Excessive nutrients in water bodies promote plant growth which leads to a drop in water quality;
2. Disruption of the natural ecosystem E.g. lack of oxygen for shelf marine life (causing a drop in their population).
3. Decrease in the recreational and aesthetic value of water bodies
4. Health problems when it occurs in drinking water reserves
5. Coral reef decline
6. Decreased biodiversity,
7. Changes in species composition and dominance, and
8. Toxicity effects.
9. Toxic phytoplankton species
10. Decreases in water transparency (increased turbidity)
11. Color, smell, and water treatment problems
12. Dissolved oxygen depletion
13. Increased incidences of fish kills
14. Loss of desirable fish species

3. Industrial water pollution: Many industries discharge waste materials containing harmful chemicals. Such Industrial wastes are called **effluents**. The river Godavari is polluted because of effluents released by the paper industry. It affects the entire water ecosystem causing enormous damage to fishes, prawns and fresh water animals.
Eg: Minamata disease & Fluorosis.
Minamata disease is a neurological syndrome caused by severe mercury poisoning. Symptoms include ataxia, numbness in the hands and feet, general muscle weakness, narrowing of the field

of vision and damage to hearing and speech. In extreme cases, insanity, paralysis, coma, and death follow within weeks of the onset of symptoms.
Minamata disease was first discovered in Minamata city in Japan in 1956. It was caused by the release of methyl mercury from, the Chisso Corporation's chemical factory, which continued from 1932 to 1968. This highly toxic chemical bio- accumulated in shellfish and fish in Minamata
Bay which when eaten by the local people resulted in mercury poisoning. While cat, dog, pig, and human deaths continued over more than 30 years, the government and company did little to prevent the pollution.
Fluorosis: People suffer from a disease called fluorosis after consuming water containing fluorine for sufficiently a long time. Quantity of fluoride in water is only 1 ppm. Diseases caused by fluorosis are:

Back pain and cannot easily bend.
Joints get stiffened as so movement of joints is impaired.
Teeth are the worst effected and a brown coating appears on the enamel of teeth giving bad appearance.
Persons with fluorosis cannot erect freely.

CONTROL MEASURES OF WATER POLLUTION:
1. Drinking water should be boiled, cooled and then used.
2. Disinfection of drinking water should be done by using chemicals like bleaching powder.
3. Pesticides and insecticides should be prevented from nearby use of water lakes,ponds and pools.
4. Drainage water should not be allowed to mix with drinking water.
5. Drainage system should be maintained properly.
6. Chlorination process is to be adopted for drinking water. For 1 litre of water 30 - 40 mg of chlorine is to be added to get perfect disinfection. It kills bacteria, fungi, fungal spores and other microbes also.

5.1.3 SOIL POLLUTION

Definition:
Soil pollution is defined as the build-up in soils of persistent toxic compounds, chemicals, salts, Radioactive materials, or disease causing agents, which have adverse effects on plant growth and animal health. Soil is the thin layer of organic and inorganic materials that covers the Earth's rocky surface. The organic portion, which is derived from the decayed remains of plants and animals, is concentrated in the dark uppermost topsoil. The inorganic portion made up of rock fragments, was formed over thousands of years by physical and chemical weathering of bedrock. Productive soils are necessary for agriculture to supply the world with sufficient food.

There are many different ways that soil can become polluted, such as:
- Seepage from a landfill
- Discharge of industrial waste into the soil
- Percolation of contaminated water into the soil
- Rupture of underground storage tanks
- Excess application of pesticides, herbicides or fertilizer
- Solid waste seepage

The most common chemicals involved in causing soil pollution are:

- Petroleum hydrocarbons
- Heavy metals
- Pesticides
- Solvents

Types of Soil Pollution

- Agricultural Soil Pollution and pollution due to urban activities
  - i) Pollution of surface soil
  - ii) Pollution of underground soil
- Soil pollution by industrial effluents and solid wastes
  - i) Pollution of surface soil
  - ii) Disturbances in soil profile

CAUSES OF SOIL POLLUTION:

Soil pollution is caused by the presence of man-made chemicals or other alteration in the natural soil environment. This type of contamination typically arises from the rupture of underground storage links, application of pesticides, and percolation of contaminated surface water to subsurface strata, oil and fuel dumping, leaching of wastes from landfills or direct discharge of industrial wastes to the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead and other heavy metals. This occurrence of this phenomenon is correlated with the degree of industrialization and intensities of chemical usage.

A soil pollutant is any factor which deteriorates the quality, texture and mineral content of the Soil or which disturbs the biological balance of the organisms in the soil. Pollution in soil has adverse effect on plant growth.

Pollution in soil is associated with

- Indiscriminate use of fertilizers
- Indiscriminate use of pesticides, insecticides and herbicides
- Dumping of large quantities of solid waste
- Deforestation and soil erosion

1. Indiscriminate use of fertilizers:

Soil nutrients are important for plant growth and development. Plants obtain carbon, hydrogen and oxygen from air and water. But other necessary nutrients like nitrogen, phosphorus, potassium, calcium, magnesium, sulfur and more must be obtained from the soil. Farmers generally use fertilizers to correct soil deficiencies. Fertilizers contaminate the soil with impurities, which come from the raw materials used for their manufacture. Mixed fertilizers often contain ammonium nitrate (NH_4NO_3), phosphorus as P_2O_5, and potassium as K_2O. For instance, arsenic, lead and cadmium present in traces in rock phosphate mineral get transferred to super phosphate fertilizer. Since the metals are not degradable, their accumulation in the soil above their toxic levels due to excessive use of phosphate fertilizers becomes an indestructible poison for crops.

The over use of NPK fertilizers reduce quantity of vegetables and crops grown on soil over the years. It also reduces the protein content of wheat, maize, grams, etc., grown on that soil. The carbohydrate quality of such crops also gets degraded. Excess potassium content in soil decreases Vitamin C and carotene content in vegetables and fruits. The vegetables and fruits grown on over fertilized soil are more prone to attacks by insects and disease.

2. Indiscriminate use of pesticides, insecticides and herbicides:

The first widespread insecticide use began at the end of World War II and included DDT **(dichlorodiphenyltrichloroethane) and gammaxene**. Insects soon became resistant to DDT and as the chemical did not decompose readily, it persisted in the environment. Since it was soluble in fat rather than water, it biomagnified up the food chain and disrupted calcium metabolism in birds, causing egg shells to be thin and fragile. As a result, large birds of prey such as the brown pelican, ospreys, falcons and eagles became endangered. DDT has been now been banned in most western countries. Ironically many of them including USA still produce DDT for export to other developing nations whose needs outweigh the problems caused by it.

The most important pesticides are DDT, BHC, chlorinated hydrocarbons, organophosphates,
aldrin, malathion, dieldrin, furodan, etc. The remnants of such pesticides used on pests may get adsorbed by the soil particles, which then contaminate root crops grown in that soil. The consumption of such crops causes the pesticides remnants to enter human biological systems, affecting them adversely.

An infamous herbicide used as a defoliant in the Vietnam War called Agent Orange (dioxin), exposure to Agent Orange.

Pesticides not only bring toxic effect on human and animals but also decrease the fertility of the soil. Some of the pesticides are quite stable and their bio- degradation may take weeks and even months.

Pesticide problems such as resistance, resurgence, and health effects have caused scientists to seek alternatives. Pheromones and hormones to attract or repel insects and using natural enemies or sterilization by radiation have been suggested

3. Dumping of large quantities of solid waste:

In general, solid waste includes garbage, domestic refuse and discarded solid materials such as Those from commercial, industrial and agricultural operations. They contain increasing amounts of paper, cardboards, plastics, glass, old construction material, packaging material and toxic or otherwise hazardous substances. Since a significant amount of urban solid waste tends to be paper and food waste, the majority is recyclable or biodegradable in landfills. Similarly, most agricultural waste is recycled and mining waste is left on site.

The portion of solid waste that is hazardous such as oils, battery metals, heavy metals from smelting industries and organic solvents are the ones we have to pay particular attention to. These can in the long run, get deposited to the soils of the surrounding area and pollute them by altering their chemical and biological properties. They also contaminate drinking water aquifer sources. More than 90% of hazardous waste is produced by chemical, petroleum and metal related industries and small businesses such as dry cleaners and gas stations contribute as well.

4. Deforestation and soil erosion:

Soil Erosion occurs when the weathered soil particles are dislodged and carried away by wind or water. Deforestation, agricultural development, temperature extremes, precipitation including acid rain, and human activities contribute to this erosion. Humans speed up this process by construction, mining, cutting of timber, over cropping and overgrazing. It results in floods and cause soil erosion.

EFFECTS OF SOIL POLLUTION

1. Agricultural

- Reduced soil fertility

- Reduced nitrogen fixation
- Increased erosion
- Larger loss of soil and nutrients
- Deposition of silt in tanks and reservoirs
- Reduced crop yield
- Imbalance in soil fauna and flora

2. Industrial

- Dangerous chemicals entering underground water
- Ecological imbalance
- Release of pollutant gases
- Release of radioactive rays causing health problems
- Increased salinity
- Reduced vegetation

3. Urban

Clogging of drains

- Inundation of areas
- Public health problems
- Pollution of drinking water sources
- Foul smell and release of gases
- Waste management problems

CONTROL MEASURES OF SOIL POLLUTION

The following steps have been suggested to control soil pollution. To help prevent soil erosion, we can limit construction in sensitive area. In general we would need less fertilizer and fewer pesticides if we could all adopt the three R's: Reduce, Reuse, and Recycle. This would give us less solid waste.

1. Reducing chemical fertilizer and pesticide use Applying bio-fertilizers and manures can reduce chemical fertilizer and pesticide use. Biological methods of pest control can also reduce the use of pesticides and thereby minimize soil pollution.

2. Reusing of materials

Materials such as glass containers, plastic bags, paper, cloth etc. can be reused at domestic levels rather than being disposed, reducing solid waste pollution.

3. Recycling and recovery of materials

This is a reasonable solution for reducing soil pollution. Materials such as paper, some kinds of plastics and glass can and are being recycled. This decreases the volume of refuse and helps in the conservation of natural resources. For example, recovery of one tonne of paper can save 17 trees.

4. Reforesting

Control of land loss and soil erosion can be attempted through restoring forest and grass cover to check wastelands, soil erosion and floods. Crop rotation or mixed cropping can improve the fertility of the land.

5. Solid waste treatment

Proper methods should be adopted for management of solid waste disposal. Industrial wastes

can be treated physically, chemically and biologically until they are less hazardous. Acidic and alkaline wastes should be first neutralized; the insoluble material if biodegradable should be allowed to degrade under controlled conditions before being disposed.

5.1.4 MARINE POLLUTION

Pollution of oceans is damaging the marine environment and is becoming a major problem. Marine environment is interesting for various reasons such as Sea food; Navigation; Adventure; Tourism etc,, Marine Pollution is harmful and its danger can be identified in a variety of ways.

Sources & causes of marine pollution:
Marine pollution originates from one of two sources --- the land or the sea which are explained below:
Marine Oil Pollution: Oil is basically an important pollutant which destroys marine environment. The various sources of oil pollution are:
Run-off oil from streets; disposal of lubricants from machines; Off shore oil and gas exploitation from off-shore drilling; blowouts at off-shore drilling rigs; oil escaping under high pressure from a bore hole in the ocean floor. **Waste chemicals, mud and accumulation of toxic substances in the ocean in theform of mercury, dioxin, PCBs, PAHs (Poly Aromatic Hydrocarbons) Radioactivity. benzene; xylene (colorless, flammable liquids) and heavy metals such as lead; copper; nickel, mercury also cause for marine pollution during the off shore drilling activities. Both dumping and exploitation of ocean resources cause ocean pollution also.**
PAHs: It is a chemical compound and organic pollutant. These occur in oil, coal and tar deposits and are produced as byproducts of fuel burning.
PAHs are lipophilic meaning they mix more easily in oil than water.
Eg for PAHs are: Acenaphthene; Anthracene; Benzopyrene; Chrysene; Coronene; Fluorene; Pyrene.

Other sources from land: The major sources of marine pollution originating from the land vary from country to country. Effluents are discharged either directly into the sea or enters the coastal waters through rivers. Thousands of barrels of oil burn when oil wells were set on fire. Tanker accidents on land carry oil to the nearby streams / canals and cause for marine Pollution. Due to burning of oil, smoke, SO2, NO2, CO is added towards atmospheric contamination.

The effects of oil pollution depend mainly on the following factors:
Type of oil and its viscosity, amount / quantity released, distance covered, time, average water temp etc..
Effects of Marine Pollution:
S No Source Effect
1 Sewage & run- off from forestry; Depletes oxygen in water causes killing of fishes. 2 Sediments from mining Sediments clog in the gills of fishes 3 Sewage from municipalities, Contaminate sea food
towns; cities etc…
4 Industrial discharge; pesticides Cause disease in coastal marine life from farms
5 Oil from off shore drilling; Low level contamination kill larvae whereas high industries/
automobiles level contamination causes death for sea fishes

6 Litter (rubbish), waste, plastics Marine life disturbs
7 Hot water from power plants Kills corals.

Marine Pollution Abatement / Prevention & control measures of Marine pollution:

The following are the some of the control measures for marine pollution:

1. Improving existing sewage disposal facilities
2. Ensuring individual houses have sewage disposal systems (such as septic tanks). 3. Large resorts should use and manage their own packaged treatment plants. 4. Marine planning and management should be considered as processes such as land – sea interaction; inter disciplinary co-operation; participation of public & private sector organizations; balance between protection and development public participation 5. Oil tankers are double hulled (two layered bottom) to reduce the chance of oil leakage 6. Recycling facilities for used oil.

NOISE POLLUTION

INTRODUCTION:

Everyone knows that sound is a form of energy that is capable of causing disturbances in human beings. Ears are the hearing organs in human beings.

A thin membrane is called Tympanum (or) ear drum receives the vibrations produced by sound to a limited extent. Human ear is capable of perceiving about 85 decibels of sound. Beyond the limit, the ear drum cannot bear sound.

In nature, we hear different types of sounds. Sound is a kind of vibration which travel through air, water, and are sensed by the ear. This is from music, speech, etc from radio / television / computers etc., one thing in this matter is that we can increase the volume of sound or decrease as per our taste whereas, a noise is a sound which cannot be heard clearly and only mixed sounds will be heard.

For eg: in an office one is talking on mobile, phone ringing another side, ring tones in some person's hands, loud conversations with one and another etc., this is called noise. One cannot increase or decrease the volume of noise. In general, a sound is a vibration from a particular machine, place or material which can be heard clearly whereas a noise a mixed vibrations that will come to us from all directions. A sound can be clear and can be able to hear, whereas a noise will not be clear and cannot be heard.

SOURCES OF NOISE:

Noise is an unwanted sound and noise pollution occurs through different sources: 1. Vehicles produce noise that leads to noise pollution.

2. Automobile industry is another source of noise pollution.
3. Noise pollution is very common in industrial areas where machines are working for factories making more noise.

The sources of noise are more in urban and industrial areas, than in rural areas. The sources of noise may be stationary or mobile. The stationary sources include industries, loud speakers, mining operations, use of machineries, TV, Radio and Grinders etc. The mobile sources include Road Traffic, Highway Noise, Railway Traffic and Air Traffic.

(1) Stationary sources:

a) Industrial noise: The main categories of industrial activity that are particularly relevant to the study of noise are the following:

Product fabrication, Product assembly, Power generation by means of generators, Combusting process in furnaces (burning of gases)

b) Noise from construction works: Construction noise, a major source of noise pollution is emitted by construction equipment. The sources of noise are dozers excavators, front end loaders, soil compactors, cranes, air compressors, concrete vibrators, riveting steel structure during

the casting, dismantling of construction materials etc...

c) Noise from other sources: These include sources such as sirens, barking dogs, ambulances, Police vehicles, Fire engines etc.

(2) Mobile sources:

Road traffic: Of all sources of noise pollution, road traffic is the most prevalent and perhaps the most source of noise pollution. More people are exposed to noise from motor vehicles and the noise depends on various factors such as Road location, Road design, Vehicle standards, Driver behaviors, Horns, Traffic density. ,

Noise of common road vehicles

Vehicle type Noise (db)

Medium road traffic (Main roads) 70- 80
Heavy road traffic (High ways) 80- 90
Buses & Trucks upto 3.5 tons 85- 95
Trucks upto 3.5-12 tons 90-100
Motor cycles 90-105

It can be observed that motor cycles with their exposed engines and inadequate silencing arrangements are notorious noise producers, which produce more than 30 times sound than a small passenger car.

a) Railway traffic: Noise from railway traffic is not serious nuisance as compared to the road traffic noise. The level of noise associated with rail traffic is related to the type of engine, the speed of the train, track type and condition. The majority of noise emitted by trains is produced by the engine (or) by the interaction of wheels with the tracks, horns, warning signals at crossings etc..,

b) Air traffic: The noise of air craft is different from that of road traffic in the sense it is intermittent. Noise is maximum during takeoff and landing. Noise made by jet planes is more disturbance than that of propeller driven air craft. Supersonic air craft produce noise at high levels due to its intensity.

EFFECTS OF NOISE:

At 120 decibels the ear registers pain but hearing damage begins about 85 decibels. Apart from hearing loss, noise can cause lack of sleep, irritation, indigestion, ulcers, High B.P., Heart diseases , Stress etc.,.

1. Annoyance (Feeling slightly angry): One of the most important effects of noise on human is

annoyance. Due to this breathing rate affects.

2.Noise- induced hearing loss: Exposure to noise for a long enough duration results in damage to the inner ear and thus decreases one's ability to hear. The louder the noise the less time it takes to cause hearing loss.

3.Effects on sleep: Noise disturbs sleep. It has been found that the cases related to various levels of noise are associated with sleep disturbances. Sleep disturbance by noise depends on the characteristics of the noise such as frequency,

loudness and whether the noise is continuous or intermittent.

Other effects: There are many other effects of noises such involve aggression (ready to attack). People may turn mad and nerves may not function normally, People may be deformed in many ways including increased stress and strain, nonfunctioning of hands, legs etc due to noise pollution if exposed continuously.

CONTROL MEASURES:

Noise pollution could be controlled by either reducing the noise at the source or by preventing its transmission.

The first step in the prevention of noise pollution is to control the noise at source itself. For eg: Lubrication of machines reduces the noise produced, Tightening the loose nuts, Reducing the vibrations produced by machines etc…

Failing to control the noise at its source, the second step is to prevent its transmission for eg: keeping the noise machine covered in an enclosure so that the sound does not escape and reach the receivers, construction of noise barriers on road sides, sound proof the buildings by using heavy curtains on the windows, acoustical tiles on the ceiling and walls, by sealing the cracks in the walls to reduce the noise coming from outside.

If the noise levels are not able to bring down to the desired levels in some cases, the only alternative is to follow:

- Avoiding horns except in emergency situations.
- Sound proof or eco-generators and Turning down the volume of stereos.
- Conducting the awareness programs

5.1.6 THERMAL POLLUTION

Thermal pollution is also known as heat pollution and occurs when heat is released into water or air that produces undesirable effects. Sudden heat release usually due to forest fire or volcanoes or human induced activities. Thermal pollution is also the addition of excess undesirable heat to water that makes it harmful to human, animal or aquatic life.

Sources of Thermal Pollution:

Various sources of thermal pollution include

Thermal Power Plants ; Nuclear Power Plants ; Petroleum Refineries; Steel Plants; Metallurgical industries; Paper Mills; Chemical Plants. Coal fired power plants constitute major sources of thermal pollution. Nuclear plants discharge much heat and also traces of toxic radioactive substances. Many industries use water for cooling purpose and thus the heat effluents are finally discharged into water.

Temperature and its effects: Temperature plays an important role in determining the conditions in which living things can survive.

Birds and mammals require a narrow range of body temp for survival whereas aquatic species can exist at a certain range of temperatures.

Thermal pollution increases water temperature causing a change (lowering) of dissolved oxygen levels. This disrupts and causes decay of plant and animal species.

For eg: The warmer water increases the metabolic rate of fish and other animals in the sea; this decreases the life expectancy of aquatic animals.

Management of Thermal Pollution:
Thermal Pollution is controlled by the following methods:
1. Cooling Towers are designed to control the temperature of water which transfers some of the heat from the water to the surrounding atmosphere by evaporation. There are two types of cooling towers namely wet cooling towers and dry cooling towers.
2. Cooling ponds are employed for thermal discharges. Heated effluents on the surface of water in cooling ponds maximize dissipation of heat to the atmosphere.
3. Artificial lakes are manmade bodies of water which offer possible alternative. The heating effluents are discharged into lake at one end and the water for cooling purpose may be withdrawn from the other end

5.1.7 NUCLEAR HAZARDS

Radioactivity is the phenomenon of emission of energy from radioactive isotopes (i.e., unstable isotopes), such as Carbon-14, Uranium-235, Uranium-238, Uranium-239, Radium-226, etc. The emission of energy from radioactive substances in the environment is often called as 'Radioactive Pollution'.

Sources/causes of nuclear hazards
The sources of radioactivity are both natural and man-made. The natural sources include: **a) Natural sources:**
1) Emissions from radioactive materials from the Earth's crust.
People have been exposed to low levels of radiation from these natural sources for several millennia. But it is the man-made sources which are posing a threat to mankind.

b) **Man-Made Sources:** The man-made sources of radioactivity are nuclear wastes (i.e., waste material that contains radioactive nuclei) produced during the:
1) Mining and processing of radioactive ores;
2) Use of radioactive material in nuclear power plants;
3) Use of radioactive isotopes in medical, industrial and research applications;
and 4) Use of radioactive materials in nuclear weapons.
The greatest exposure to human beings comes from the diagnostic use of X-rays, radioactive isotopes used as tracers and treatment of cancer and other ailments.

Effects of nuclear hazards:
The effects of radioactive pollutants depend upon half-life, energy releasing capacity, rate of diffusion and rate of deposition of the contaminant. Various atmospheric conditions and climatic

conditions such as wind, temperature and rainfall also determine their effects. The effects may be somatic (individual exposed is affected) or genetic (future generations) damage. The effects are cancer, shortening of life span and genetic effects or mutations.

Some of the possible effects are listed as under:

1) Radiations may break chemical bonds, such as DNA in cells. This affects the genetic make-up and control mechanisms. The effects can be instantaneous, prolonged or delayed types. Even

it could be carried to future generations.

2) Exposure at low doses of radiations (100-250 rads), men do not die but begin to suffer from fatigue, nausea, vomiting and loss of hair. But recovery is possible.

3) Exposure at higher doses (400-500 rads), the bone marrow is affected, blood cells are reduced, natural resistance and fighting capacity against germs is reduced, blood fails to clot, and the irradiated person soon dies of infection and bleeding.

4) Higher irradiation doses (10,000 rads) kill the organisms by damaging the tissues of heart, brain, etc.

5) Workers handling radioactive wastes get slow but continuous irradiation and in course of time develop cancer of different types.6) Through food chain also, radioactivity effects are experienced by man.

But the most significant effect of radioactivity is that it causes long range effects, affecting the future of man and hence the future of our civilization.

Control measures:

On one hand, the peaceful uses of radioactive materials are so wide and effective that modern civilization cannot go without them; on the other hand, there is no cure for radiation damage. Thus the only option against nuclear hazards is to check and prevent radioactive pollution. For this:

1) Leakages from nuclear reactors, careless handling, transport and use of radioactive fuels, fission products and radioactive isotopes have to be totally stopped;
2) Safety measures should be enforced strictly;
3) Waste disposal must be careful, efficient and effective;
4) There should be regular monitoring and quantitative analysis through frequent sampling in the risk areas;
5) Preventive measures should be followed so that background radiation levels do not exceed the permissible limits;

6) Appropriate steps should be taken against occupational exposure; and
7) Safety measures should be strengthened against nuclear accidents

5.2 SOLID WASTE MANAGEMENT

Solid wastes are the material that arises from various human and economic activities. It is being produced since the beginning of civilization. Ever increasing population growth, urbanization and industrialization are contributing to the generation of solid waste in huge quantities.

Waste is enviable; waste is by product of human activity which has lack of use. The term waste refers to the useless material generated from different sources such as household, public places, hospital, commercial centre construction sites and production of waste from industries.

Waste can be classified through various methods on the basis of physical state (solid, liquid and gaseous) and then within solid waste (according to its original use packaging waste, food waste etc.) material (glass, paper etc.) physical properties, domestic, commercial, biodegradable, non biodegradable etc. Solid wastes have prevailing characteristics which sets them apart from the liquid and gaseous wastes.

The characteristics are that the waste remains highly visible in the environment. Liquid wastes are quickly relegated to sewer and are out of sight and gaseous wastes disperse in to the atmosphere. Accumulation of large quantities of solid wastes is having an adverse impact on the environment.

There are many waste types defined by modern systems of waste management, notably including:

- municipal solid waste (MSW)
- construction waste and demolition waste (C&D)
- institutional waste, commercial waste, and industrial waste (IC&I)
- medical waste (also known as clinical waste)
- hazardous waste, radioactive waste, and electronic waste
- biodegradable waste

Waste management is the collection, transport, processing, recycling or disposal, and monitoring of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is also carried out to recover resources from it. Waste management can involve solid, liquid, gaseous or radioactive substances, with different methods and fields of expertise for each.

Effects

a) Health Hazard

If solid wastes are not collected and allowed to accumulate, they may create unsanitary conditions. This may lead to epidemic outbreaks. Many diseases like cholera, diarrhea, dysentery, plague, jaundice, or gastro-intestinal diseases may spread and cause loss of human

lives. In addition, improper handling of the solid wastes is a health hazard for the workers who come in direct contact with the waste.

b)Environmental Impact

If the solid wastes are not treated properly, decomposition and putrefaction may take place, causing land and water pollution when the waste products percolate down into the underground water resources. The organic solid waste during decomposition may generate obnoxious odors. Stray dogs and birds may sometimes invade garbage heaps and may spread it over the neighborhood

causing unhygienic and unhealthy surroundings.

Control measures

An integrated waste management strategy includes three main

components 1. Source reduction

2. Recycling

3. Disposal

Source reduction is one of the fundamental ways to reduce waste. This can be done by using less material when making a product, reuse of products on site, designing products or packaging to reduce their quantity. On an individual level we can reduce the use of unnecessary items while shopping, buy items with minimal packaging, avoid buying disposable items and also avoid asking for plastic carry bags.

Recycling is reusing some components of the waste that may have some economic value. Recycling has readily visible benefits such as conservation of resources reduction in energy used during manufacture and reducing pollution levels. Some materials such as aluminum and steel can be recycled many times. Metal, paper, glass and plastics are recyclable. Mining of new aluminum is expensive and hence recycled aluminum has a strong market and plays a significant role in the aluminum industry. Paper recycling can also help preserve forests as it takes about 17 trees to make one ton of paper. Crushed glass (cullet) reduces the energy required to manufacture new glass by 50 percent. Cullet lowers the temperature requirement of the glassmaking process thus conserving energy and reducing air pollution.

However even if recycling is a viable alternative, it presents several problems. The problems associated with recycling are either technical or economical. Plastics are difficult to recycle because of the different types of polymer resins used in their production. Since each type has its own chemical makeup different plastics cannot be recycled together. Thus separation of different plastics before recycling is necessary. Similarly in recycled paper the fibers are weakened and it is difficult to control the colour of the recycled product. Recycled paper is banned for use in food containers to prevent the possibility of contamination. It very often costs less to transport raw paper pulp than scrap paper. Collection, sorting and transport account for about 90 percent of the cost of paper recycling.

The processes of pulping, deinking and screening wastepaper are generally more expensive than making paper from virgin wood or cellulose fibers. Very often thus recycled paper is more expensive than virgin paper. However as technology improves the cost will come down.

Disposal of solid waste is done most commonly through a sanitary landfill or through incineration. A modern sanitary landfill is a depression in an impermeable soil layer that is lined with an impermeable membrane. The three key characteristics of a municipal sanitary landfill that distinguish it from an open dump are:

• Solid waste is placed in a suitably selected and prepared landfill site in a carefully prescribed manner.

• The waste material is spread out and compacted with appropriate heavy machinery.

• The waste is covered each day with a layer of compacted soil. The problems with older landfills are associated with groundwater pollution. Pollutants seeping out from the bottom of a sanitary landfill (leachates) very often percolate down to the groundwater aquifer no matter how thick the underlying soil layer. Today it is essential to have suitable bottom liners and leachate collection systems along with the installation of monitoring systems to detect groundwater pollution.

The organic material in the buried solid waste will decompose due to the action of microorganisms. At first the waste decomposes aerobically until the oxygen that was present in the freshly placed fill is used up by the aerobic microorganisms. The anerobes take over producing methane which is poisonous and highly explosive when mixed with air in concentrations between 5 and 15 percent. The movement of gas can be controlled by providing impermeable barriers in the landfill. A venting system to collect the blocked gas and vent it to the surface where it can be safely diluted and dispersed into the atmosphere is thus a necessary component of the design of sanitary landfills.

Even though land filling is an economic alternative for solid waste disposal, it has become increasingly difficult to find suitable land filling sites that are within economic hauling distance and very often citizens do not want landfills in their vicinity. Another reason is that no matter how well engineered the design and operation may be, there is always the danger of some environmental damage in the form of leakage of leachates. Incineration is the process of burning municipal solid waste in a properly designed furnace under suitable temperature and operating conditions. Incineration is a chemical process in which the combustible portion of the waste is combined with oxygen forming carbon dioxide and water, which are released into the atmosphere.

This chemical reaction called oxidation results in the release of heat. For complete oxidation the waste must be mixed with appropriate volumes of air at a temperature of about 815o C for about one hour.

Incineration can reduce the municipal solid waste by about 90 percent in volume and 75 percent in weight. The risks of incineration however involve airquality problems and toxicity and disposal of the fly and bottom ash produced during the incineration process. Fly ash consists of finely divided particulate matter, including cinders, mineral dust and soot. Most of the incinerator ash is bottom ash while the remainder is fly ash. The possible presence of heavy metals in incinerator ash can be harmful. Thus toxic products and materials containing heavy metals (for example batteries and plastics) should be segregated.

Thus extensive air pollution control equipment and high-level technical supervision and skilled employees for proper operation and maintenance is required. Thus while sanitary landfills and incinerators have their own advantages and disadvantages, the most effective method of solid waste management is source reduction and recycling.

Vermi – Composting

Nature has perfect solutions for managing the waste it creates, if left undisturbed. The biogeochemical cycles are designed to clear the waste material produced by animals and plants. We can mimic the same methods that are present in nature. All dead and dry leaves and twigs decompose and are broken down by organisms such as worms and insects, and is finally broken down by bacteria and fungi, to form a dark rich soil-like material called compost.

These organisms in the soil use the organic material as food, which provides them with nutrients for their growth and activities. These nutrients are returned to the soil to be used again by trees and other plants. This process recycles nutrients in nature. This soil can be used as a manure for farms and gardens.

5.3 ROLE OF INDIVIDUALS IN PREVENTION OF POLLUTION

The role of an individual in maintaining a pollution free, pure and congenial environment and in preserving its resources is actually the need of the hour. Individuals can, however, play an important role in abatement of air, water, soil or noise pollution in the following simple manners:

1) Use low-phosphate, phosphate-free or biodegradable dishwashing liquid, laundry detergent, and shampoo.
2) Don't use water fresheners in toilets.
3) Use manure or compost instead of commercial inorganic fertilizers to fertilize gardens and yard plant.
4) Use biological methods or integrated pest management to control garden, yard, and household pests.
5) Don't pour pesticides, paints, solvents, oils, or other products containing harmful chemicals down drain or on the ground. Contact the authorities responsible for their disposal.
6) Recycle old motor oil and antifreeze at an auto service center that has an oil recycling program

7) If you get water from a private well or suspect that municipal water is contaminated, have tested by an EPA certified laboratory for lead, nitrates, trihalomethanes, radon, volatile, organic compounds and pesticides.
8)Run water from taps for several minutes every morning before using the water for drinking or cooking. Save it and use it to water plants.
If you have a septic tank, monitor it yearly and have it cleaned out every three to five years by a reputable contractor so that it won't contribute to groundwater pollution. Do not use Septic tank cleaner, which contain toxic chemicals that can kill bacteria important to sewage Decomposition and that can contaminate groundwater if systems malfunction. 9) Support ecological land-use planning in your community.
10) Get to know your local water bodies and form watchdog groups to help monitor, protect, and restore them.

5.4 DISASTER MANAGEMENT

Disaster means a terrible event that causes a great damage / loss to the human beings. It is a situation arising from natural forces where large scale disruption of infrastructure, services etc. occurs. It causes a serious impact on human life, economy and environment. Natural disasters are always severe and sudden.

Some disasters are:
(A) Geological: in nature like the earthquakes;
(B) Landslides (rocks slides down from the side of a hill); Volcanic eruptions etc.. (C) Climatic disasters / Natural calamities: These are of different types affect nations all over the world. Because of the large geographical size of the country, India often faces natural calamities like floods, cyclones and drought occurring frequently in different parts of the country.

Natural calamities are of two types:

1. Major calamities: eg: earthquakes; droughts; floods, tsunamis; cyclones etc 2. Minor calamities: eg: hailstorms; avalanches; fire accidents

(D) Man induced disasters include wars, battles, riots, rail/road accidents, nuclear explosions.

The disaster Management: The natural disaster management involves the following steps: Relief measures: it include rescue tools; communication equipments; heavy machines to remove debris; water pumps; technicians; drugs, doctors, ambulances..

Disaster predictions: The predictions of natural hazards may be made on the basis of past history of the area with regular monitoring of the environmental changes caused by human activities to assess the genesis of natural disasters.

Education: Disaster education plays a significant role in disaster education. It create awareness and improve the standards to prevent from the disasters.
Geographic Information Systems: (GIS): GIS is a system that captures, stores, analyzes , manages and presents data with reference to geographic location of the area. In simple terms, GIS is the merging of cartography, statistical analysis and database technology. GIS may be used in Archaeology, Geography, Remote Sensing, Land surveying; Natural Resource Management;

Urban Planning etc. GIS programs help by means of maps available data of the problem areas, to predict the severity of the disaster.

Floods

Floods are high stream flow that overflows the natural banks of the rivers and most of the times become calamitous. India is the most flood affected nation after Bangladesh. Out of total deaths by Floods in the world, (1/5) are from India. The main causes of floods are excessive rains in river catchments, poor natural drainage, Change of river course, Landslide restricting river flow, cyclone and very intense rainfall. Over that past few years the rise in population is forcing large settlements along the river banks, making the country highly vulnerable to Floods. The most vulnerable states of India are Uttar Pradesh, Bihar, Assam, West Bengal, Gujarat, Orissa, Andhra Pradesh, Madhya Pradesh, Maharashtra, and PunjabandJammu&Kashmir. In 1994, a major flood killed 147 people in Kerala, 138 in Gujarat and marooned 10000 in Madhya Pradesh. In 1995, the states of Uttar Pradesh, Haryana and Arunachal Pradesh were severely hit by flood causing huge casualties. In the year 1996, a fierce flood literally paralyzed India, Thousands of people died, got homeless,

were marooned in the states of Rajasthan, Andhra Pradesh, Jammu & Kashmir also affecting many other parts of the country. In short, nearly every year one or the other part of the country is severely hit by Floods and creating a shameful history for India. It is high time that the policies and measures for various preventions and disaster management activities are properly implemented. Development of flood risk maps, flash flood run off modeling, water logging problems, systems for monitoring and management of flood using remote sensing and GIS.

Earth-quakes Earthquakes occur due to the sudden movements in the earth crust. The earth's crust has several tectonic plates of solid rocks which slowly move along their boundaries. When friction prevents these plates from slipping, stress builds up and results in the sudden fractures which occur along their boundaries of the plates or fault lines (planes of weakness) within the plates. This causes earthquakes, the violent, short term vibrations in the earth. The point on a fault at which the first movement occurs during an earth quake is called the epicenter. The severity of an earthquake is generally measured by its magnitude on RichterScale. **Richter scale Severity of earthquake**

Less than 4 Insignificant

4-4.9 Minor
5-5.9 Damaging
6-6.9 Destructive
7-7.9 Major
8-8.9 Great

Damage to property and life can be prevented by monitoring of buildings and structures under Strong Earth Motion, experimental and analytical investigations on structures to predict their behavior under earthquake conditions, strengthening through retrofits, development of

earthquake resistant design methodologies, better materials, risk assessment, preparation of seismic codes, seismic zonation and development of risk specific designs

Landslides

Landslides are mass movement of rocks and debris that usually follow a cyclone, volcano or earthquake. In the hilly areas of India, the sliding of huge masses of land has been a common natural disaster causing havoc to life and property. One of the worst and most disastrous landslides has been recorded in the year 1998 in the state of Uttarakhand, when nearly 380 people were killed. As a measure of concern many committees and other measures have been taken to protect from this natural havoc in India. In India, the regions of Himalayas and the Western ghats are the most vulnerable to these land-slides. The main causes of landslides are weak, weathered materials, physical property variation, Ground Uplift, erosion, Earthquake, Volcanic eruptions etc. The general and simple mitigation that are adopted or should be adopted are drainage correction, proper land-utilization, reforestation and spreading of awareness.

Cyclones

Cyclone refers to a whirl in the atmosphere with very strong winds circulating around it in anti

clockwise direction in the Northern Hemisphere and clockwise in the Southern Hemisphere. Cyclones are intense low pressure areas with pressure increasing outwards. Cyclones can be hazardous as Cyclones are normally associated with strong winds. A storm surge is an abnormal rise of sea level near the coast caused by a severe tropical cyclone; as a result, sea water inundates low lying areas of coastal regions drowning human beings and lives- stock, eroding beaches and embankments, destroying vegetation and reducing soil fertility. Apart from strong winds, cyclones can result in heavy rains causing floods. However, the most destructive factor associated with the cyclones is the storm surge. The worst and the oldest cyclone in India were in 1737, in Calcutta that took 300000 lives respectively. For cyclone forecast and advance warning, the Government has strengthened the Meteorological Department, by providing Cyclone Surveillance Radars at Calcutta, Paradeep, Visakhapatnam, Machilipatnam, Madras and Karaikal in the east coast and at Cochin, Goa, Bombay and Bhuj in the west coast. As India has a vast coastline it is extremely vulnerable to cyclone.

6. HUMAN POPULATION AND THE ENVIRONMENT E-WASTE

Front panel of CRTs	Barium (Ba)	Short term exposure causes: • Muscle weakness; • Damage to heart, liver and spleen.
Motherboard	Berylli um (Be)	• Carcinogenic (lung cancer) • Inhalation of fumes and dust. Causes chronic beryllium disease or beryllicosis. • Skin diseases such as warts.

MANAGEMENT OF E-WASTES

It is estimated that 75% of electronic items are stored due to uncertainty of how to manage it. These electronic junks lie unattended in houses, offices, warehouses etc. and normally mixed with household wastes, which are finally disposed off at landfills. This necessitates implementable management measures.

In industries management of e-waste should begin at the point of generation. This can be done by waste minimization techniques and by sustainable product design. Waste minimization in industries involves adopting:

- inventory management,
- production-process modification,
- volume reduction,
- Recovery and reuse.

Inventory management

Proper control over the materials used in the manufacturing process is an important way to reduce waste generation (Freeman, 1989). By reducing both the quantity of hazardous Materials used in the process and the amount of excess raw materials in stock, the quantity of waste generated can be reduced. This can be done in two ways i.e. establishing material-purchase review and control procedures and inventory tracking system.
Another inventory management procedure for waste reduction is to ensure that only the needed quantity of a material is ordered. This will require the establishment of a strict inventory tracking system. Purchase procedures must be implemented which ensure that materials are ordered only on an as-needed basis and that only the amount needed for a specific period of time is ordered.

Production-process modification
Changes can be made in the production process, which will reduce waste generation. This reduction can be accomplished by changing the materials used to make the product or by the more efficient use of input materials in the production process or both. Potential waste minimization techniques can be broken down into three categories:
i) Improved operating and maintenance procedures,
ii) Material change and
iii) Process-equipment modification.

Volume reduction
Volume reduction includes those techniques that remove the hazardous portion of a waste from a non-hazardous portion. These techniques are usually to reduce the volume, and thus the cost of disposing of a waste material. The techniques that can be used to reduce waste-stream volume can be divided into 2 general categories: source segregation and waste concentration. Segregation of wastes is in many cases a simple and economical technique for waste reduction. Wastes containing different types of metals can be treated separately so that the metal value in the sludge can be recovered. Concentration of a waste stream may increase the likelihood that the material can be recycled or reused. Methods include gravity and vacuum filtration, ultra filtration, reverse osmosis, freeze vaporization etc.
For example, an electronic component manufacturer can use compaction equipments to reduce volume of waste cathode ray-tube.

Recovery and reuse
This technique could eliminate waste disposal costs, reduce raw material costs and provide income from a salable waste. Waste can be recovered on-site, or at an off-site recovery facility, or through inter industry exchange. A number of physical and chemical techniques are available to reclaim a waste material such as reverse osmosis, electrolysis, condensation, electrolytic recovery, filtration, centrifugation etc. For example, a printed-circuit board manufacturer can use electrolytic recovery to reclaim metals from copper and tin-lead plating bath.

However recycling of hazardous products has little environmental benefit if it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to redesign the product to use nonhazardous materials, such recycling is a false solution.

Sustainable product design

Minimization of hazardous wastes should be at product design stage itself keeping in mind the following factors*

- **Rethink the product design:** Efforts should be made to design a product with fewer amounts of hazardous materials. For example, the efforts to reduce material use are reflected in some new computer designs that are flatter, lighter and more integrated. Other companies propose centralized networks similar to the telephone system.
- **Use of renewable materials and energy:** Bio-based plastics are plastics made with plant-based chemicals or plant-produced polymers rather than from petrochemicals. Bio based toners, glues and inks are used more frequently. Solar computers also exist but they are currently very expensive.
- **Use of non-renewable materials that are safer:** Because many of the materials used are non-renewable, designers could ensure the product is built for re-use, repair and/or upgradeability. Some computer manufacturers such as Dell and Gateway lease out their products thereby ensuring they get them back to further upgrade and lease out again.

PLASTICS WASTE MANAGEMENT

Environmental Issues and Challenges

The quantum of solid waste is ever increasing due to increase in population, developmental activities, changes in life style, and socio-economic conditions, Plastics waste is a significant portion of the total municipal solid waste (MSW).
It is estimated that approximately 10 thousand tons per day (TPD) of plastics waste is generated i.e. 9% of 1.20 lacs TPD of MSW in the country.

The plastics waste constitutes two major categories of plastics;

(i) Thermoplastics: Thermoplastics, constitutes 80% and thermoset constitutes approximately 20% of total post-consumer plastics waste generated in India. The Thermoplastics are recyclable plastics.
Eg: Polyethylene Terephthalate (PET), Low Density Poly Ethylene (LDPE), Poly Vinyal Chloride (PVC), High Density Poly Ethylene (HDPE), Polypropylene (PP), Polystyrene (PS) etc.

(ii) Thermoset plastics: Thermoset plastics contains alkyd, epoxy, ester, melamine formaldehyde, phenolic formaldehyde, silicon, urea formaldehyde, polyurethane, metalised and multilayer plastics etc.

The environmental hazards due to mismanagement of plastics waste include the following aspects:

- Littered plastics spoil beauty of the city and choke drains and make important public Places filthy;
- Garbage containing plastics, when burnt may cause air pollution by emitting polluting Gases;
- Garbage mixed with plastics interferes in waste processing facility and may also cause Problems in landfill operations;
- Recycling industries operating in non-conforming areas are posing unhygienic Problems to the environment.

Main Features of the Plastics Manufacture and Usage(Amendment) Rules, 2003

Regulation of plastics waste, particularly manufacture and use of recycled plastics carry bags and

containers is being regulated in the country as per "Recycled Plastics Manufacture and Usage Rules, 1999 and as amended in 2003. According to these Rules:

1.No person shall manufacture, stock, distribute or sell carry bags made of virgin or recycled plastic bags which are less than 8 x 12 inches in size and having thickness less than 20 microns.

2. No vendor shall use carry bags/containers made of recycled plastics for storing, carrying, dispensing or packaging of food stuffs

3. Carry bags and containers made of recycled plastic and used for purposes other than storing and packaging food stuffs shall be manufactured using pigments and colorants as per IS 9833:1981 entitled "List of pigments and colorants for use in plastics in contact with food stuffs, pharmaceuticals and drinking water"

4.Recycling of plastics shall be undertaken strictly in accordance with the Bureau of Indian Standard specification: IS 14534:1998 entitled "The Guidelines for Recycling of Plastics"

5.Manufacturers of recycled plastic carry bags having printing facilities shall code/mark carry Bags and containers as per Bureau of Indian Standard specification: IS 14534:1998 (The Guidelines for Recycling of Plastics).

6. No person shall manufacture carry bags or containers irrespective of its size or weight unless the occupier of the unit has registered the unit with respective SPCB/PCC prior to the commencement of production.

7. The prescribed authority for enforcement of the provisions of these rules related to manufacturing and recycling is SPCB in respect of States and the PCC in Union Territories and for relating to use, collection, segregation, transportation and disposal shall be the District Collector/ Deputy Commissioner of the concerned district

Options for Plastic Waste Management

Recycling of plastics through environmentally sound manner:

Recycling of plastics should be carried in such a manner to minimize the pollution during the process and as a result to enhance the efficiency of the process and conserve the energy. Plastics recycling technologies have been historically divided into four general types -primary, secondary, tertiary and quaternary.

- **Primary** recycling involves processing of a waste/scrap into a product with characteristics similar to those of original product.
- **Secondary** recycling involves processing of waste/scrap plastics into materials that have characteristics different from those of original plastics product.
- **Tertiary** recycling involves the production of basic chemicals and fuels from plastics

waste/scrap as part of the municipal waste stream or as a segregated waste. **Quaternary**

recycling retrieves the energy content of waste/scrap plastics by burning / incineration. This process is not in use in India.

Steps Involved in the Recycling Process

1.Selection: The recyclers / reprocessors have to select the waste / scrap which are suitable for recycling /reprocessing.
2.Segregation: The plastics waste shall be segregated as per the Codes 1-7 mentioned
3.Processing: After selection and segregation of the pre-consumer waste (factory waste) shall be directly recycled. The post consumer waste (used plastic waste) shall be washed, shredded, agglomerated, extruded and granulated

Polymer Coated Bitumen Road
The CPCB has undertaken a project in collaboration with Thiagarajar College of Engineering Madurai to evaluate the performance of polymer coated built roads laid during 2002-2006 in different cities.
The observations are as below:

- The coating of plastics over aggregate improves Impact, Los Angels Abrasion and Crushing Value with the increase in the percentage of plastics.
- The extracted bitumen showed almost near value for Marshall stability.
- The entire road was having good skid resistance and texture values.
- All the stretches in the roads have been found reasonably strong.
- The unevenness index values of these roads are nearly 3000 mm/km, which indicate a good surface evenness.
- The plastic tar roads have not developed any potholes, rutting, raveling or edge flaw, even though these roads are more than four years of age.
- Polymer coated aggregate bitumen mix performs well compared to polymer modified bitumen mix.
- Higher percentage of polymer coating improves the binding strength of the mix.
- Foam plastics have better binding values.

6.3 WATERCONSERVATION

Water being one of the most precious and indispensable resources needs to be conserved.
The following strategies can be adopted for conservation of water.

1. **Decreasing run-off losses:** Huge water-loss occurs due to run-off on most of the soils, which can be reduced by allowing most of the water to infiltrate into the soil.
This can be achieved by using contour cultivation, terrace framing, water spreading, chemical treatment or improved water-storage system.

a) Contour cultivation: on small furrows and ridges across the slopes trap rainwater and allow more time for infiltration. Terracing constructed on deep soils have large water storage capacity. On gentle slopes trapped run off is spread over a large area for better infiltration

b) Conservation-bench terracing: It involves construction of a series of benches for catching the runoff water.

c) Water spreading is done by channeling or lagoon-leveling, In channeling, the water flow is controlled by a series of diversions with vertical intervals. In lagoon leveling, small depressions are dug in the area so that there is temporary storage water d) Chemical wetting agents (Surfactants): These seem to increase the water intake rates when added to normal irrigated soil.

e) Surface crop residues, tillage, mulch, animal residues etc. help in reducing run-off by allowing more time for water to penetrate into the land.

f) Chemical conditioners like gypsum ($CaSO_4.2H_2O$) when applied to sodic soils improve soil permeability and reduce run off. Another useful conditioner is HPAN(hydrolyzed polyacrylonitrile)

g) Water-storage structures like farm ponds, dug-outs etc. build by individual farmers can be useful measures for conserving water through reduction of runoff.

2. **Reducing evaporation losses:** This is more relevant in humid regions. Horizontal barriers of asphalt placed below the soil surface increase water availability and increase crop yield by 35-40%. This is more effective on sandy soil but less effective on loamy sand soils. A co-polymer of starch and acrylonitrile called 'super slumper' has been reported to absorb water up to 1400 times its weight. The chemical has been found to be useful for sandy soils.

3. Storing water in soil: Storage of water takes place in the soil root zone in humed regions when the soil is wetted to field capacity. By leaving the soil fallow for one season water can be made available for the crop grown in next season.

4. Reducing irrigation losses:

a) Use of lined or covered canals to reduce seepage

b) Irrigation in early morning or late evening to reduce evaporation losses c) Sprinkling irrigation and drip irrigation to conserve water by 30-50%

d) Growing hybrid crop varieties with less water requirements and tolerance to saline Water help conserve water.

5. Reuse of water:

a) Treated wastewater can be used for ferti-irrigation

b) Using grey water from washings, bath-tubs etc. for watering gardens, washing cars or paths help in saving fresh water.

6. **Preventing wastage of water:** This can be done in households, commercial buildings and public places.

a) Closing taps when not in use

b) Repairing any leakage from pipes

c) Using small capacity flush in toilets.

7. **Increasing block pricing:** The consumer has to pay a proportionately higher bill with higher use of water. This helps in economic use of water by the consumer

RAIN WATER HARVESTING

Introduction:

The term rainwater harvesting is being frequently used these days, however, the concept of water harvesting is not new for India. Water harvesting techniques had been evolved and developed centuries ago.

Ground water resource gets naturally recharged through percolation. But due to indiscriminate development and rapid urbanization, exposed surface for soil has been reduced drastically with resultant reduction in percolation of rainwater, thereby depleting ground water resource. Rainwater harvesting is the process of augmenting the natural filtration of rainwater in to the underground formation by some artificial methods. "Conscious collection and storage of rainwater to cater to demands of water, for drinking, domestic purpose & irrigation is termed as Rainwater Harvesting.

Why to harvest rain water?

- To arrest ground water decline and augment ground water table
- To beneficiate water quality in aquifers
- To conserve surface water runoff during monsoon
- To reduce soil erosion
- To inculcate a culture of water conservation

Rainwater harvesting can be harvested from the following surfaces:

Rooftops: If buildings with impervious roofs are already in place, the catchment area is effectively available free of charge and they provide a supply at the point of consumption.

Paved and unpaved areas i.e., landscapes, open fields, parks, storm water drains, roads and pavements and other open areas can be effectively used to harvest the runoff. The main advantage in using ground as collecting surface is that water can be collected from a larger area. This is particularly advantageous in areas of low rainfall.

Water bodies: The potential of lakes, tanks and ponds to store rainwater is immense. The harvested rainwater can not only be used to meet water requirements of the city, it also recharges groundwater aquifers.

Storm water drains: Most of the residential colonies have proper network of storm water drains. If maintained neatly, these offer a simple and cost effective means for harvesting rainwater.

Types of Harvesting System

Broadly rainwater can be harvested for two purposes

A. Roof top rain water harvesting (RTRWH)

B. Charged into the soil for withdrawal later (groundwater recharging)

A. Roof top rain water harvesting (RTRWH)

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

Components of Roof top Rainwater harvesting system:

The system mainly constitutes of following sub components**:**

- Catchment, Coarse mesh, Gutters, Conduits or Conveyance
- Transportation
- First flush
- Filter
- Storage
- Supply unit

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1. **Catchments:** The catchment of a water harvesting system is the surface which directly receives the rainfall and provides water to the system. It can be a paved area like a terrace or courtyard of a building, or an unpaved area like a lawn or open ground. A roof made of reinforced cement concrete (RCC), galvanized iron or corrugated sheets can also be used for water harvesting.