

Environmental Science and Disaster Management

Lecture: 1

1. Introduction:

Environment is derived from the French word Environner, which mean encircle or surrounding. Environment is a complex of many variables, which surrounds man as well as the living organisms. Environmental studies describe the interrelationships among organisms, the environment and all the factors, which influence life on earth, including atmospheric conditions, food chains, the water cycle, etc. It is a basic science about our earth and its daily activities, and therefore, this science is important for one and all.

1.1 Scope of environmental studies

Environmental studies discipline has multiple and multilevel scopes. This study is important and necessary not only for children but also for everyone. The scopes are summarized as follows:

1. The study creates awareness among the people to know about various renewable and nonrenewable resources of the region. The endowment or potential, patterns of utilization and the balance of various resources available for future use in the state of a country are analysed in the study.
2. It provides the knowledge about ecological systems and cause and effect relationships.
3. It provides necessary information about biodiversity richness and the potential dangers to the species of plants, animals and microorganisms in the environment.
4. The study enables one to understand the causes and consequences due to natural and man induced disasters (flood, earthquake, landslide, cyclones etc.,) and pollutions and measures to minimize the effects.
5. It enables one to evaluate alternative responses to environmental issues before deciding an alternative course of action.
6. The study enables environmentally literate citizens (by knowing the environmental acts, rights, rules, legislations, etc.) to make appropriate judgments and decisions for the protection and improvement of the earth.
7. The study exposes the problems of over population, health, hygiene, etc. and the role of arts, science and technology in eliminating/ minimizing the evils from the society.
8. The study tries to identify and develop appropriate and indigenous eco-friendly skills and technologies to various environmental issues.
9. It teaches the citizens the need for sustainable utilization of resources as these resources are inherited from our ancestors to the younger generation without deteriorating their quality.
10. The study enables theoretical knowledge into practice and the multiple uses of environment.

1.2 Importance of environmental study

Environmental study is based upon a comprehensive view of various environmental systems. It aims to make the citizens competent to do scientific work and to find out practical solutions to current environmental problems. The citizens acquire the ability to analyze the environmental parameters like the aquatic, terrestrial and atmospheric systems and their interactions with the biosphere and anthrosphere.

1.3 Importance

- World population is increasing at an alarming rate especially in developing countries.
- The natural resources endowment in the earth is limited.
- The methods and techniques of exploiting natural resources are advanced.
- The resources are over-exploited and there is no foresight of leaving the resources to the future generations.
- The unplanned exploitation of natural resources lead to pollution of all types and at all levels.
- The pollution and degraded environment seriously affect the health of all living things on earth , including man.
- The people should take a combined responsibility for the deteriorating environment and begin to take appropriate actions to space the earth.
- Education and training are needed to save the biodiversity and species extinction.
- The urban area, coupled with industries, is major sources of pollution.
- The number and area extinct under protected area should be increased so that the wild life is protected at least in these sites.
- The study enables the people to understand the complexities of the environment and need for the people to adapt appropriate activities and pursue sustainable development, which are harmonious with the environment.
- The study motivates students to get involved in community action, and to participate in various environmental and management projects.
- It is a high time to reorient educational systems and curricula towards these needs.
- Environmental studies take a multidisciplinary approach to the study of human interactions with the natural environment. It integrates different approaches of the humanities , social sciences, biological sciences and physical sciences and applies these approaches to investigate environmental concerns.
- Environmental study is a key instrument for bringing about the changes in the knowledge, values, behaviors and lifestyles required to achieve sustainability and stability within and among countries.

Environmental studies deals with every issue that affects an organism. It is essentially a multidisciplinary approach that brings about an appreciation of our natural world and human impacts on its integrity. It is an applied science as it seeks practical answers to making human civilization sustainable on the earth's finite resources. Its components include

1. Biology
2. Geology
3. Chemistry
4. Physics
5. Engineering
6. Sociology
7. Health
8. Anthropology
9. Economics
10. Statistics
11. Philosophy

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2. Major environmental issues

Man and nature have lived together and as long as man's wants were in conformity with nature, there was no problem. But unfortunately, man's ambition for limitless enjoyment and comfort has led him towards the exploitation of nature's wealth so indiscriminately as to reduce nature's capacity for self-stabilization. The indiscriminate exploitation of nature over centuries has created numerous environmental problems. Man's voracious appetite for resources and his desire to conquer nature has put him on collision course with environment. The demands of his explosive technological society impose intense stress on the state of equilibrium with the environment. Major environmental issues threatening mankind are Global warming, water pollution, pesticide pollution, Hazardous waste, biomedical wastes, e waste, and loss of biodiversity

India today is one of the first ten industrialized countries of the world. Today we have a good industrial infrastructure in core industries like metals, chemicals, fertilizers, petroleum, food etc. What has come out of these?, Pesticides, detergents, plastics, solvents, paints, dyes, food additives etc. Due to progress in atomic energy, there are also been an increase in radioactivity in the biosphere. Besides these there are a number of industrial effluent and emissions particularly poisonous gases in the atmosphere. Mining activities also added to this problem particularly as solid waste.

Such activities of man had adverse effect on all forms of living organisms in the biosphere. The

earth planet along with the atmosphere (air, land, water) that sustains life is called the Biosphere. Due to lack of development of a culture of pollution control, there has resulted a heavy backlog of gaseous, liquid and solid pollution in our country. The solid wastes which causes pollution are Hazardous waste, pesticides, medical waste etc. they are become the major environmental issues in addition to automobile pollution, climate change, water pollution, pesticide pollution and biodiversity loss in our country and worldwide.

2.1 Industrial / Vehicular pollution

The coolest culprits of environmental degradation in metropolitan cities are vehicular and industrial pollution. Since 1975 the Indian economy has grown 2.5 times, the industrial pollution load has grown 3.47 times and the vehicular pollution load 7.5 times, in Delhi, for example 70% of air pollution is caused by vehicular pollution. Thanks to the 3 million vehicles on its roads-while industries account for 17%. The pollutants emitted by the vehicles could produce inflammatory effects on the respiratory organs, could be toxic or even carcinogenic depending upon the fuel type, In India, vehicles primarily run on diesel or petrol.

2.2 Water pollution

India has 12 major rivers with a total catchments area of 252.8 million hectare. The Indian homes produce about 75 % of the wastewater, and sewage treatment facilities are inadequate in most cities and almost absent in rural India. According to the Central pollution Control Board, of the 8,432 large and medium industries in the country, only 4,989 had installed appropriate measures to treat wastewater before discharge. Of the over two million small scale industrial units, a number of which like tanneries are extremely polluting, very few have any treatment facilities whatsoever and their untreated wastes invariably find their way into country's watersystems.

2.3 Poisoned by Pesticides

Poisoning from pesticides affects 68,000 farmers and workers every day; annually, an estimated 25 million workers suffer from pesticide poisoning throughout the world. Farmers and agricultural workers are exposed to pesticides directly when they are mixing and spraying these pesticides, especially so in developing countries such as Asia. Every year, about 3 million people are poisoned around the world and 200,000 die from pesticide use.

2.4 Pesticides In Soft Drinks

Soft drinks are non-alcoholic water-based flavored drinks that are optionally sweetened, acidulated and carbonated. Some carbonated soft drinks also contain caffeine; mainly the brown-colored cola drinks. The two global majors PepsiCo and Coca-Cola dominate the soft drink

market in India.

2.5 Biomedical Waste

Biomedical waste includes both organic and inorganic wastes generated from hospitals. On an average a hospital bed generates 1 kg of waste per day, out of which 10-15% is infectious, 5% is hazardous and rest is general waste. Every day, country's numerous hospitals and medical facilities churn out tonnes of waste. A WHO report documents that Hepatitis – B Virus can survive in a syringe for 8 days.

2.6 Cracking down on crackers

Over the years, Diwali has turned into a festival of pollution by noise, crackers, artificially coloured sweets and serious health hazards. On this day, cities turn into gas chambers as toxic fumes and gases like CO₂, SO₂, NO₂, as well as suspended particulate matter (SPM), increase in the air. The worst affected are children, pregnant women and those suffering from respiratory problems. In addition, the factories making crackers flout safety norms and exploit child labour. These children work for 16-18 hrs each day in unhygienic dingy, make-shift and suffocating factories for only Rs.10-15 per day. They handle chemicals that cause deadly diseases of the lungs, kidneys, skin and eyes.

2.7 Loss of Biodiversity

The continuous loss of biodiversity due to over exploitation, habitat degradation, deforestation and land pollution has posed a serious threat to the very existence of mankind. It has been calculated that if this trend of biodepletion continues, about 1/4th of the world's species may be extinct by the year 2050. The rate of destruction which has been of the order of one species per year over the past 600 million years is today feared to be dozens of species a day. Hence, the conservation of biodiversity has become one of the most pressing environmental issues. The challenge is for nations, government agencies, organizations and individuals to protect and enhance biological diversity, while continuing to meet people's need for natural resources.

We are at a major turning point in human history and for the first time, we now have the resources, motivation, and knowledge to protect our environment and to build a sustainable future for ourselves and our children. Until recently, we didn't have these opportunities, or there was not enough clear evidence to inspire people to change their behavior and invest in environmental protection; now the need is obvious to nearly everyone. Unfortunately, this also may be the last opportunity to act before our problems become irreversible.

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3. Natural Resources:

A resource is anything needed by an organism or group of organisms. The sum of all physical, chemical, biological and social factors, which compose the surroundings of man, is referred as environment and each element of these surroundings constitutes a resource on which man draws in order to develop a better life. Resources which are not reproducible and are obtained from the finite non-living reserves are called non-renewable resources (eg.) Coal and metals.

Any material which can be transformed in a way that it becomes more valuable and useful can be termed as a resource. Thus, only part of our natural environment, such as land, water, air, minerals, forest, rangeland, wildlife, fish or even human population that man can utilize to promote his welfare may be regarded as a natural resource. In the case of humans, a resource is any form of energy or matter essential for the fulfillment of physiological, socio-economic and cultural needs, both at the individual level and that of the community.

The five basic ecological variables - energy, matter, space, time and diversity are sometimes combinedly called natural resources.

Renewable

- Perpetual harvest
- Ex. Human power, fertility of soil

Non-renewable

- No-replacement
- Ex. Species of wildlife

Based on Continual Utility

- Renewable
- Nonrenewable
- Cyclic resource

Based on origin

- Biotic and
- Abiotic

Based on Utility

- some as raw materials
- some as energy resources

Renewable resources are those which are reproducible and are obtained from the biomass of living organisms. (Eg.) Forests. Potentially renewable can become nonrenewable resources, if used for a prolonged time at a faster rate than it is renewed by natural processes.

3.1 Land

The land although appears to be available unlimited but, infact, its judicious use would limit the availability of this indispensable life support system. In rural land use planning, concentration is chiefly devoted to creating and developing more farmland by removing forests and natural grasslands, channeling streams for irrigation and so on. Unfortunately, no effort is made to save existing prime farmland from degradation by ill planned development.

A nation's well-being is inextricably linked with the fertility and abundance of soil resources. Productive land is since the source of human sustenance and security everywhere at all times, this resource because of mounting demands of swelling population and long mismanagement would put in jeopardy the very survival of man.

Deteriorating quality of urban and sub urban environment is to a great extent the result of injudicious land use and is a threat to the whole socio economic system. Major problems emerging out of abuse of land in cities include unsafe and unhygienic dwellings and those in rural areas are of erosion of soil and loss of fertility. While urban problems can be prevented and cured by proper town planning and municipal facilities, the problem relating to rural areas need long-term soil conservation programme.

3.1.1 Soil development

- Pedogenesis – lichens, bacteria, fungi, algae, microarthropods, mollusc – secretion of Organic acids, enzymes, CO₂, addition of Organic Matter – leads to soil formation – soilProfile
- Factors affecting soilformation
 - Passive Factors – Parent material, topography,time
 - Active Factors – Rainfall, Temp, humidity,Wind,
 - Biosphere effect (Phytosphere, Zoosphere,MO)

Throughout history, the progress of civilizations has been marked by a trail of wind-blown or water-washed soils that resulted in barren lands. Continuing to use the soil without appropriate soilconservation management is very destructive to the environment. Protecting the quality of our nation's topsoil is largely within human control. To many soil scientists, saving our soil is much more important than saving oil, coal, or natural gas resources

3.2 Water Resources

Water is a vitally important substance in all parts of the environment. Water resources occupy a unique place among other natural sources. It is the most abundant and most widely distributed element in the world. It occupies about three fourths (70%) of the earth's surface. It occurs in all spheres of the environment – in the oceans as a vast reservoir of saltwater, on land as surface water in lakes and rivers, underground as groundwater in the atmosphere as water vapor, and in the polar icecaps as solid ice. This amounts to a staggering 1400 million cubic kilometer, which is enough to cover the earth with a layer 3000 meters deep. This apparent abundance is, however, misleading and hides an ironical fact which is not always fully appreciated, a mammoth 97.5% of the amount, contained in the world's oceans and seas, being saline, is unfit for human consumption. We, like many creatures, require fresh water to survive, and that constitute a miserly 2.5 % of the total amount. Of this, about 68.9% lies inaccessible in ice fields and glaciers and another 29.9% is present as groundwater. In effect, only one – hundredth of three per cent (0.03%) of the world's total supply amounting to some 14 billion cubic meters is considered easily available for human use on a regular basis. This water is found in decreasing order of abundance in saline and freshwater lakes and reservoirs; as soil moisture; as water held in living organisms, as vapor, droplets, and miniscule ice crystals in the atmosphere; in swamps and marshes; and in rivers and streams. The problem would not have been so acute had freshwater been evenly distributed around the globe, throughout the seasons or from year to year. It is not so. Two thirds of the world's population i.e around 4 billion people lives in areas receiving only one quarter of the world's annual rainfall.

3.2.1 Freshwater distribution

About three-quarters of annual rainfall come down in areas containing less than one-third of the world's population. As water –short societies have done for centuries, many countries attempt to move water from where it occurs on nature to where the people want it, and also to store water for future use. Worldwide, there are 40,000 dams higher than 15 mts, most of them built in the last 50 years. Although dams help ensure a steady water supply, they often endanger aquatic systems by blocking river channels, altering water flows of rivers, food plains, deltas, and other natural wetlands, as well as imperiling plant and animal life.

3.2.2 How water is used?

The amount of water that people in a country actually use depends not only on minimum needs and how much water is available for use but also on the level of economic development and the extent of urbanization. Globally, of the three categories of freshwater use- for agriculture, industry and domestic, agriculture dominates. On a worldwide basis, agriculture accounts for about 69% of the annual water withdrawals; industry, about 23% and domestic use, about 8%.

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4. India's Water Resources Potential

India receives an annual precipitation of about 4000 cu.km. About 1869 cu.km occurs as natural run off in rivers. India has 12 major rivers with a total catchments area of 252.8 million hectare. Of these, the Ganga-Brahmaputra-Meghana system is the biggest with a catchment area of about 110 m.ha. It also provides about 60% of the total amount of freshwater amongst other rivers. Others with catchment areas of more than 10 m.ha are Indus (32.1 m.ha), Godavari (31.3 m.ha.), Krishna (25.9 m.ha.) and Mahanadi (14.2 m.ha.) The national annual per capita availability of water in the country is about 2208cu.m.

4.1 Groundwater

In India groundwater has been used for irrigation and domestic water supply since time immemorial. At present, more than 70% of the population uses groundwater for its domestic needs and more than half of the irrigation is provided from this source. The total replenishable ground water in India is estimated to be about 43.18850 million hectare meter per year. About 7.1 m ha m/yr is used for domestic and industrial use. It is estimated that about 32.47264 m ha m/yr is available for irrigation. About 32% of available groundwater resources have so far been used. There is increasing extraction of groundwater to meet the demands of the agriculture, especially for the cultivation of water intensive crops, like sugarcane. Some 90% of the groundwater extracted is used for irrigation. Today, more than 8.5 million electric and diesel pumps are used to withdraw groundwater leading to falling water tables in most states.

4.2 Water Pollution

The Indian homes produce about 75 % of the wastewater, and sewage treatment facilities are inadequate in most cities and almost absent in rural India. According to the Central pollution Control Board, of the 8,432 large and medium industries in the country, only 4,989 had installed appropriate measures to treat wastewater before discharge. Of the over two million small scale industrial units, a number of which like tanneries are extremely polluting, very few have any treatment facilities whatsoever and their untreated wastes invariably find their way into country's water systems. Management of water implies making the best use available water resources for human benefit while not only preventing and controlling its depletion and degradation but also developing it in view of the present and future needs. Floods, droughts, improper use, pollution, disease transmission are the important problems related to water.

4.3 Drought

Drought may be caused due to variability of rainfall, delay in onset or early withdrawal of monsoon, duration of break in the monsoon, area differences in persistence of monsoon and human activities. Based on the physical characteristics, drought may be of meteorological drought, hydrological drought, soil-moisture drought, agricultural drought, socio-economic drought, famine and ecological drought.

4.3.1 Combating drought

Planning for drought includes;

- Scientific use of rainfall, surface and undergroundwater.
- Introduction of proper croppingpattern.
- Development of irrigationfacilities.
- Development of existing irrigationpotential.
- Lining of canals and distributaries to minimize waterlosses.
- Drip irrigation/Trickle irrigation mainly in salineareas.
- Expeditious completion of continuing projects should be given priority inplanning.
- Construction of new irrigationprojects.
- Desilting of irrigationtanks.
- Technology of dryfarming.

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5. Forest:

It is a natural ecosystem having multispecies and multiage trees as dominant community. Forest covers about 1/3rd of the earth's land surface of which about 50% is occupied by tropical forest. Thus forests are important in two ways ecologically and economically important.

Increased urbanization, industrialization and mining have entailed indiscriminate felling of trees and denudation of forests. The depleted forest wealth would simply deprive the man of economic and environmental values offered by forest Thus, forest ecology is a highly diverse and important branch of ecological study. The presence of trees makes forest ecosystems and their study unique.

5.1 Causes of Deforestation

Deforestation is a consequence of over-exploitation of our natural ecosystems for space, energy and materials. The basic reasons for such extensive deforestationare:

1. Expansion of Agriculture:

Expanding agriculture is one of the most important causes of deforestation. As demands on agricultural products rise more and more land is brought under cultivation for which forests are cleared, grass-lands ploughed, uneven grounds leveled, marshes drained and even land under water is reclaimed. However, this expansion is usually marked with more ecological destruction than rationality. Governments often distribute land under forests to landless people, instead of redistributing already established farm-lands, howsoever, wasteful, unequal and unjust the distribution of ownership of land may be. During the process of clearing the land precious timber is simply burned. Ghana's 80% forests have disappeared but only 15% timber was harvested. Similarly in Brazil, little timber was extracted before the forests were burned for clearing the land.

2. Extension of Cultivation on Hill Slopes:

Outside humid tropical zone, in most of the third world countries, major forests often occur on hill tops and slopes. Though agriculture has nearly always been concentrated on plains and floors of valleys, farming on narrow flat steps cut one after another across the slope or terrace farming is an age-old practice. It has never been extensive because of the gruelling labour and low productivity. However, the ever rising human numbers and their necessities have forced many to go up to mountain slopes for cultivation. More and more slopes are cleared of plants, steps carved out and against many odds cultivation is attempted. After a few crops the productivity declines and torrential sub-tropical rains carry down massive quantities of precious top soils to streams and rivers. While denuding hill slopes, the silt and sediments settle further down raising stream bottoms and river beds aggravating the flood situation.

3. Shifting Cultivation:

Shifting cultivation or Jhum is often blamed for destruction of forests. In fact it is poor fertility of soil which has given rise to such a pattern of farming. A small patch of tropical forest is cleared, vegetation slashed, destroyed and burned. Crops are grown as long as the soil is productive, after which the cultivation is abandoned and cultivators move on to fresh patch of land. The abandoned land was allowed to lay fallow for long periods during which regrowth of vegetation took place and natural ecosystem was restored. Shifting cultivators, therefore, worked in harmony with nature. However, the demands of growing population have shortened the fallow periods drastically. The soil is unable to regain its fertility before it is put to use again.

4. Cattle Ranching:

Large areas of tropical forests in North Eastern States have been cleared for use as grazing land to raise cattle and agricultural purpose. The soil degenerates within a short span of time due to over-grazing and massive soil erosion occurs.

5. Firewood Collection:

To majority of rural population and a large number of people living in small towns and cities of developing countries, the only fuel is wood which is burned to cook food and to provide heat in chilly winters. Firewood collection contributes much to the depletion of tree cover, especially in localities which are lightly wooded. Denser forests usually produce a lot of combustible material in the form of dead twigs, leaves etc. There is hardly any need of cutting down live trees in densely wooded localities. However, in the case of lightly wooded forests, where the pressure of demand is usually higher, a slow thinning of woodland occurs due to regular foraging of villagers. In Madhya Pradesh, India, a recent observation revealed that felling of small trees for use as firewood and timber exceeds fresh plant growth. In some places in the state, the Government! Allows people to collect head loads of dead wood from forests for personal use.

6. Timber Harvesting:

Timber resource is an important asset for a country's prosperity. Commercial wood finds ready national as well as international markets. As a consequence of which natural forests are being mercilessly exploited. Logging or felling of forest trees for obtaining timber is an important cause of deforestation in third world countries. Live trees with thick and straight trunks are felled and transported to commercial establishments elsewhere, to consumers who are ready to pay. In the process large stretches of forests are damaged and the system which could have provided resources worth much more to the local people is disrupted. Ironically the profits from timber trade are enjoyed by Governments, large companies or affluent contractors. Local people get a tiny share in the benefits while axing their own resourcebase.

7. Wildlife

It was once customary to consider all undomesticated species of vertebrate animals as wildlife. Birds and mammals still receive the greatest public interest and concern, consistently higher than those expressed for reptiles and amphibians. Most concern over fishes results from interest in sport and commercial value. The tendency in recent years has been to include more life-forms under the category of wildlife. Thus, mollusks, insects, and plants are all now represented on national and international lists of threatened and endangered species.

5.2 Wildlife Management and Conservation:

The conservation is the practice of preservation, maintenance, sustainable utilization, restoration and enhancement of the natural environment. Conservation is judicious management of resources towards their optimum utilization. Wild life management includes maintenance of habits suitable to the different species. Both governmental and non-governmental and voluntary organizations at state and central levels have been set up to protect wildlife. Ministry of Environment and Forest has been entrusted with the task of environmental protection.

5.2.1 Wildlife Management:

- Protection of natural habitats through controlled, limited exploitation of species.
- Maintenance of the viable number of species in protected areas (National Park, Sanctuary, Biosphere reserve etc.)
- Establishment of Biosphere Reserves for plants and animal species
- Protection through legislation.
- Improving the existing protected areas.
- Imposing restrictions on export of rare plant and animal species and their products.
- Educating public for environmental protection at all levels of education.

5.2.2 Governmental Organizations:

1. Indian Board of Wildlife (IBWC), 1952
2. Madras Wild Elephant Preservation Act, 1873
3. All-India Elephant Preservation Act, 1879
4. The Wild Birds and Animals Protection Act, 1912
5. Bengal Rhinoceros Preservation Act, 1932
6. Assam Rhinoceros Preservation Act, 1954
7. Wildlife (Protection) Act, 1972
8. Becoming a Part to CITES, 1976

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6. Energy sources

Fossil fuels such as coal, gas or oil represent the principal source of energy and supply about eighty five per cent of the commercial energy requirement. Fossil fuels are types of sedimentary organic materials, often loosely called bitumens, with asphalt, a solid, and petroleum, the liquid form. More correctly bitumens are sedimentary organic materials that are soluble in carbon disulfide.

Petroleum consists largely of paraffins or simple alkanes, with smaller aromatic compounds such as benzene present in most crude oils. Natural gas is an abundant fossil fuel that consists largely of methane and ethane, although traces of higher alkanes are present. Coal, unlike petroleum, contains only a little hydrogen. Fossil evidence shows that coal is mostly derived from the burial of terrestrial vegetation with high proportion of lignin and cellulose.

Nuclear power is an attractive alternative to fossil fuels and considered as "the clear energy alternative". Damming rivers to create hydroelectric power from spinning water turbines has the attraction of providing a low-cost, renewable, air pollution-free energy source.

6.1 Conventional exhaustible energy sources:

Firewood:

Man has been logging down the trees for various purposes including to get firewood as an important one. This led to thinning of woodland that had serious consideration from both ecological and economic viewpoints. The only way out to the problem is making available to the village the cheaper non-conventional energy sources, such as biogas and solar energy in usable form.

Fossil fuel:

Are the most extensively used sources of energy today. Increase in population and per capita energy demand coupled with the industrialization at a faster rate are factors responsible for depletion of fossil fuel. Petroleum and natural gas today fulfill 60% of the world's total energy requirements. If the exploitation and consumption of these resources continues at the present incredible rate, their supply may be lost only for a few more decades.

6.2 Non-conventional and in-exhaustible energy sources:

The rapid depletion of conventional energy sources has prompted governments and people to concentrate on finding and tapping some non-conventional energy sources that may last for long. The in-exhaustible energy sources like solar, hydro, tidal, wind and atomic power, can only bring hope for the sustained socio-economic development of humanity.

Solar energy:

Research and application in the field of solar energy have opened new vistas in the direction of fulfilling world's future energy requirements. It is especially drawn attention for its practically free steady supply and pollution free use. This resource can especially be tapped more effectively in the regions where there are long run shine hours. Department of non-conventional energy sources of Government of India has prepared a prospective plan that envisages generation of energy through non-conventional sources. Chiefly solar, to the extent of 250 million tons of coal replacement per annum.

Wind Power:

The power of wind is being used in running mills, irrigation of fields and carrying out other farm activities. According to DNES, Government of India, 20,000 MW electricity can be generated from the wind alone.

Hydropower:

It is considered to be the cheapest source of electricity. The Brahmaputra basin has the highest hydropower potential and nearly 30% of the country's production. Next to it rank the Indus, Godavari and Ganga basins respectively. Apart from economic consideration development of such projects is beneficial for irrigation and other purposes.

Atomicpower:

Atomic power appears to be the only hope for large-scale energy requirements when fossil fuels are exhausted. Atomic energy has its application not only in generation of electricity but has successfully been used in chemical and food processing industry. The important constraints in atomic energy generation are cost of construction and maintenance of plants and also disposal of radioactive wastes.

Bio-energy:

Organic wastes provide an important renewable source of energy. It is considered to be advantageous in view of its relatively cheaper supply, and use of organic wastes in its generation reduces the impending threat of pollution due to their release in environment. As such, it serves two purposes; fuel production and waste disposal. It has more practical applicability in villages where organic waste, in the form of cattle dung, is available in plenty. Biogas so generated is thus economic and convenient to use as compared to conventional practice of burning of dry dung cakes.

6.3 FoodResources

We have thousands of edible plants and animals over the world, out of which only about three dozen types constitute the major food of humans. The main food resources include wheat, rice, maize, potato, barley, oats, cassava, sugarcane, pulses, sorghum, millet, about 20 or 50 common fruits and vegetables, milk, meat, fish and sea food. 76% of world food is produced from croplands and most is produced grains. About 17% of world food is obtained from Rangeland (Meat etc). Seven % of world food supplied by oceanic fisheries. About 30,000 plant species are edible. 2/3 of the people used traditional grains (rice, wheat etc.). People consume more beef, pork, chicken; egg etc., Fish and sea food are the important sources of food. Milk products are also widely used.

6.3.1 World Food Problems

- The world population increases and cultivable land area decreases.
- Due to the inadequate rainfall, the productivity of food is reduced by every year.
- Environmental degradation like soil erosion, water logging, water pollution, salinity, affects agricultural lands.

- Urbanization is another problem for the reduction of agricultural lands.

6.3.2 Indian Scenario

- India is the 3rd largest producer of crops, but 300 million Indians are still undernourished
- Land wise, India is only half as much of USA, but population wise three times higher.
- Food problem is directly related to population growth.

6.3.3 Under Nutrition and Malnutrition

To maintain good health and resistant disease, we need large amount of macronutrients such as carbohydrates, proteins, fats and smaller amount of micronutrients such as vitamins A, C and E and minerals such as iron, calcium and iodine.

6.3.4 Under nutrition

- The Food and Agriculture Organization (FAO) of United Nations estimated that on an average, minimum calorie intake on a global scale is 2,500 calories per day.
 - Peoples receiving less than 90% of these minimum dietary calories are called undernourished.
 - If it is less than 80% that are said to be seriously undernourished.
 - People who cannot buy enough food to meet their basic energy needs (carbohydrates) suffer from undernutrition.
1. During the last 50 years world grain production has increased almost three times. But, at the same time, population growth increased at such a rate in LDCs (Less Developed Countries).
 2. Every year 40 million people (50% of children (15 year) die on undernourishment and malnutrition. This means that every year our food problem is killing as many people were killed by the atomic bomb dropped on Hiroshima during World War II.
 3. In countries like North America and Europe the daily average calorie intake is about 3500 cal, which is nearly one-third more than that required for healthy living.

6.3.5 Indian Scenario

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

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7. Ecosystems:

Ecology is the science that deals with the relationships between living organisms with their physical environment and with each other. Ecology can be approached from the viewpoints of (1) the environment and the demands it places on the organisms in it or (2) organisms and how they adapt to their environmental conditions. An ecosystem consists of an assembly of mutually interacting organisms and their environment in which materials are interchanged in a largely cyclical manner. An ecosystem has physical, chemical, and biological components along with energy sources and pathways of energy and materials interchange. The environment in which a particular organism lives is called its habitat. The role of an organism in a habitat is called its niche.

For the study of ecology it is often convenient to divide the environment into four broad categories.

1. Terrestrial environment - The terrestrial environment is based on land and consists of biomes, such as grasslands, one of several kinds of forests, savannas, and deserts.
2. Freshwater environment - The freshwater environment can be further subdivided between *standing-water habitats* (lakes, reservoirs) and *running-water habitats* (streams, rivers).
3. Oceanic marine environment - The oceanic marine environment is characterized by saltwater and may be divided broadly into the shallow waters of the continental shelf composing the neritic zone
4. Oceanic region - The deeper waters of the ocean that constitute the oceanic

region. Two major subdivisions of modern ecology are

- Ecosystem ecology - which views ecosystems as large units, and
- Population ecology - which attempts to explain ecosystem behavior from the properties of individual units.

In practice, the two approaches are usually merged. Descriptive ecology describes the types and nature of organisms and their environment, emphasizing structures of ecosystems and communities and dispersions and structures of populations. Functional ecology explains how things work in an ecosystem, including how populations respond to environmental alteration and how matter and energy move through ecosystems.

Ecosystems are broadly divided into natural and artificial. *Natural ecosystems* are those that are existing in nature; they are further classified into terrestrial and aquatic. Terrestrial includes hot desert, grass land, tropical and temperate rainforest and *aquatic* includes ponds, river, streams, lakes, estuaries, oceans, mangroves, swamps and bays etc. However these two ecosystems are self regulating, open system with a free exchange of inputs and outputs with other systems. Artificial ecosystems are simple, human-made, unstable and subjected to human intervention and manipulation. Usually it is formed by clearing a part of the forest or grassland e.g. crop field, agricultural land.

7.1 Structure and Function of an ecosystem

An ecosystem has two components the biotic components consisting of living things, and the abiotic portion, consisting of elements that are not alive. The non living constituents are said to include the following category, habitat, gases, solar radiation, temperature, moisture and inorganic and organic nutrients. The living organisms may be sub divided into producers, consumers and decomposers. Abiotic Components include basic inorganic and organic components of the environment or habitat of the organism. The inorganic components of an ecosystem are carbon dioxide, water nitrogen, calcium phosphate all of which are involved in matter cycle (biogeochemical cycles). The organic components of an ecosystem are proteins, carbohydrates, lipids and amino acids, all of which are synthesized by the biota (flora and fauna) of an ecosystem and are reached to ecosystem as their wastes, dead remains etc. the climate 'microclimate' temperature, light soil etc. are abiotic components of the ecosystems.

7.1.1 Functions of an Ecosystem

Ecosystem function is the capacity of natural processes and components to provide goods and services that satisfy human needs, either directly or indirectly. Ecosystem functions are subset of ecological processes and ecosystem structures. Each function is the result of the natural processes of the total ecological sub-system of which it is a part. Natural processes, in turn, are the result of complex interactions between biotic (living organisms) and abiotic (chemical and physical) components of ecosystems through the universal driving forces of matter and energy. **There are four primary groups of ecosystem functions** (1) regulatory functions, (2) habitat functions, (3) production functions and (4) information functions. This grouping concerns all ecosystems, not only forforests.

7.1.2 General characterization of ecosystem functions are:

Regulatory functions: this group of functions relates to the capacity of natural and semi-natural ecosystems to regulate essential ecological processes and life support systems through biogeochemical cycles and other biospheric processes. In addition to maintaining the ecosystem (and biosphere health), these regulatory functions provide many services that have direct and indirect benefits to humans (i.e., clean air, water and soil, and biological controlservices).

Habitat functions: natural ecosystems provide refuge and a reproduction habitat to wild plants and animals and thereby contribute to the (in situ) conservation of biological and genetic diversity and the evolutionary process.

Production functions: Photosynthesis and nutrient uptake by autotrophs converts energy, carbon dioxide, water and nutrients into a wide variety of carbohydrate structures which are then used by secondary producers to create an even larger variety of living biomass. This broad diversity in

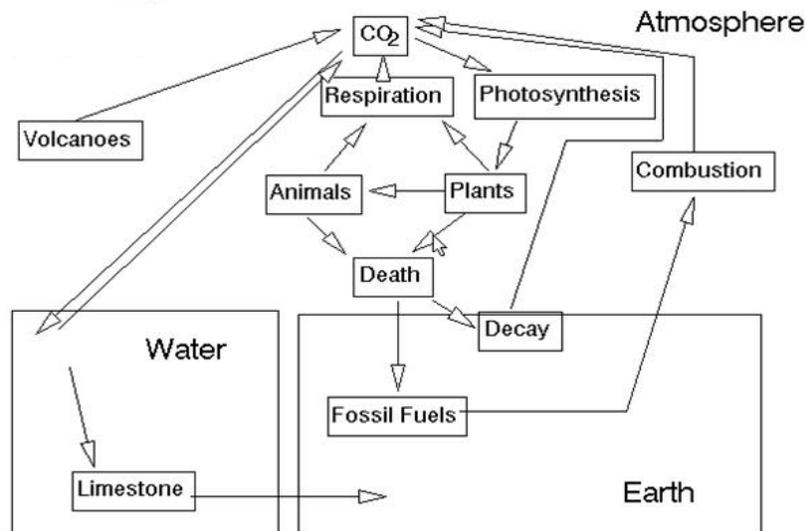
carbohydrate structures provides many ecosystem goods for human consumption, ranging from food and raw materials to energy resources and genetic material.

Information functions: Since most of human evolution took place within the context of an undomesticated habitat, natural ecosystems contribute to the maintenance of human health by

7.2 Carbon Cycle

Carbon, the basic building block of life molecules, is circulated through the carbon cycle. This cycle shows that carbon may be present as gaseous atmospheric CO_2 , dissolved in groundwater as HCO_3^- or molecular $\text{CO}_2(\text{aq})$, in underlying rock strata as limestone (CaCO_3), and as organic matter, represented in a simplified manner as (CH_2O) . Photosynthesis fixes inorganic carbon as biological carbon, which is a constituent of all life molecules.

An important aspect of the carbon cycle is that it is the cycle by which energy is transferred to biological systems. Organic or biological carbon, (CH_2O) , is an energy-rich molecule that can react biochemically with molecular oxygen, O_2 , to regenerate carbon dioxide and produce energy. This can occur in an organism as shown by the “decay” reaction or it may take place as combustion, such as when wood is burned.



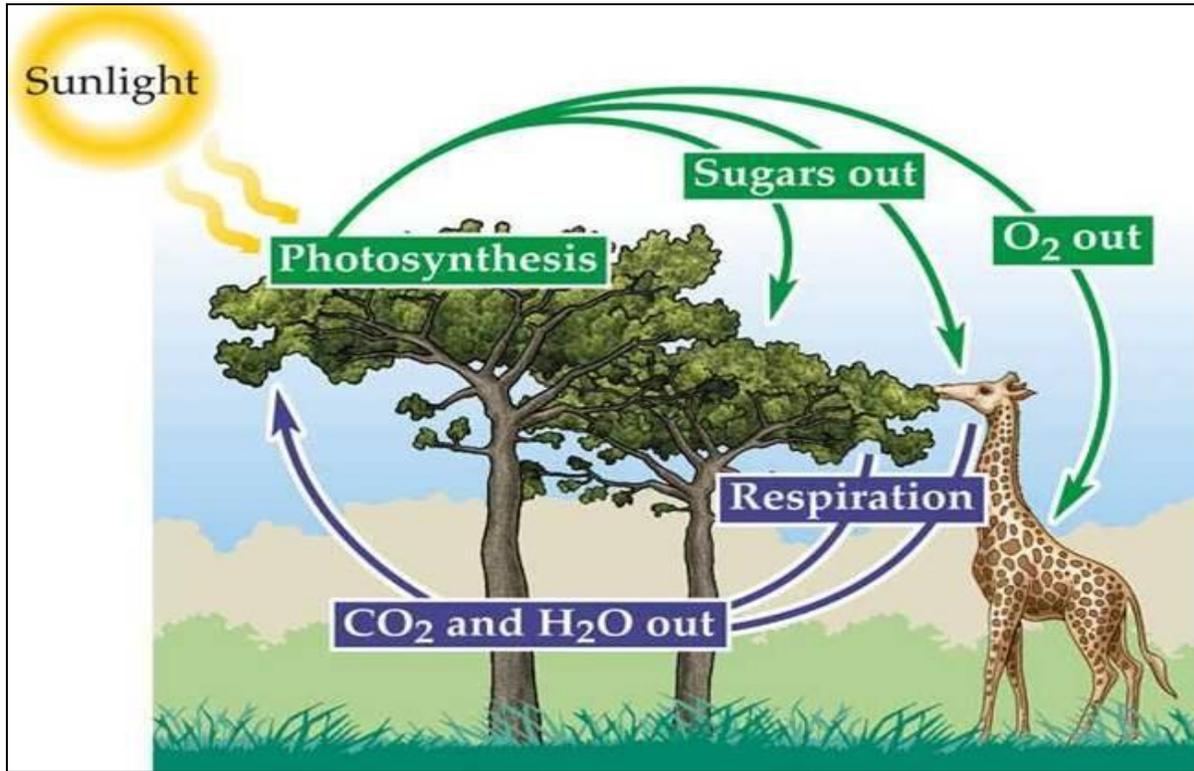
Lecture: 8

8. Oxygen Cycle

The oxygen cycle involves the interchange of oxygen between the elemental form of gaseous O_2 in the atmosphere and chemically bound O in CO_2 , H_2O , and organic matter. Elemental oxygen becomes chemically bound by various energy-yielding processes, particularly combustion and

metabolic processes in organisms. It is released during photosynthesis.

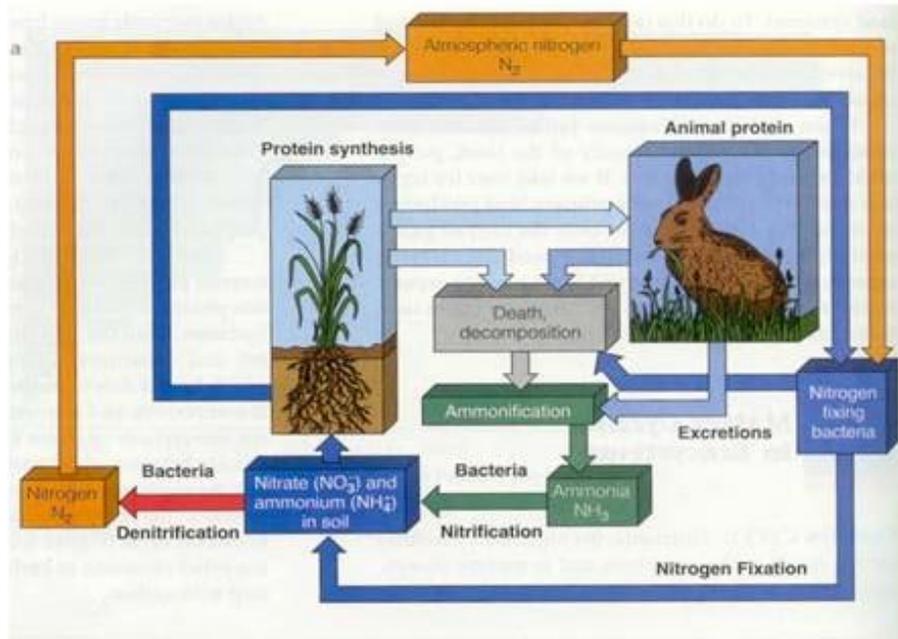
Oxygen Cycle



8.1 Nitrogen Cycle

Nitrogen, though constituting much less of biomass than carbon or oxygen, is an essential constituent of proteins. The atmosphere is 78% by volume elemental nitrogen, N₂ and constitutes an inexhaustible reservoir of this essential element. The N₂ molecule is very stable so that breaking it down to atoms that can be incorporated in inorganic and organic chemical forms of nitrogen is the limiting step in the nitrogen cycle. This does occur by highly energetic processes in lightning discharges such that nitrogen becomes chemically combined with hydrogen or oxygen as ammonia or nitrogen oxides. Elemental nitrogen is also incorporated into chemically bound forms or fixed by biochemical processes mediated by microorganisms. The biological nitrogen is returned to the inorganic form during the decay of biomass by a process called mineralization.

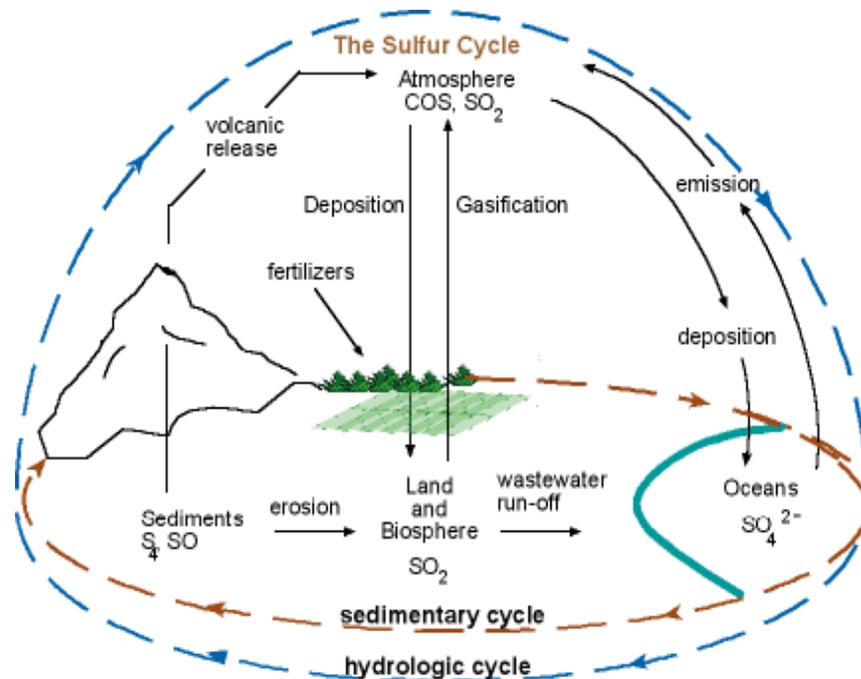
Nitrogen Cycle



8.2 Sulphur cycle

The sulfur cycle is relatively complex. It involves several gaseous species, poorly soluble minerals, and several species in solution. It is involved with the oxygen cycle in that sulfur combines with oxygen to form gaseous sulfur dioxide (SO_2) an atmospheric pollutant, and soluble sulfate ion, (SO_4^{2-}). Among the significant species involved in the sulfur cycle are gaseous hydrogen sulfide, H_2S ; mineral sulfides, such as PbS ; sulfuric acid, H_2SO_4 , the main constituent of acid rain; and biologically bound sulfur in sulfur-containing proteins.

Sulfur cycle



It should be obvious that material cycles, often based on elemental cycles, are very important in the environment.

Lecture: 9

9. Ecosystem:

Our environment consisting of both living and non-living systems, influence each other in form, function and property which is necessary to maintain life. The composition of the living and the non-living systems are the building blocks of an ecosystem.

9.1 Producers

In an ecosystem, producers are those organisms that use photosynthesis to capture energy by using sunlight, water and carbon dioxide to create carbohydrates, and then use that energy to create more complex molecules like proteins, lipids and starches that are crucial to life processes. Producers, which are mostly green plants, are also called autotrophs.

Producers funnel into the ecosystem the energy needed for its biological processes. The carbohydrates and other organic chemicals formed by the producers are utilized by the heterotrophs, or consumers; first by the herbivores who eat the plants--the primary consumers--then by the predators who eat the herbivores--the secondary, tertiary, and so on consumers. But at each step, much energy is lost. Less than 10 percent of the energy stored in plants is converted to herbivore mass. The loss from herbivore to predator is similar. Thus energy needs to be added to the ecosystem continuously.

9.2 Consumers

Consumers are organisms (including humans) that get their energy from producers, regarding the flow of energy through an ecosystem. For example, producers, (such as plants), make their own food by the process of photosynthesis. An organism ate this plant, than it would be a primary consumer. The animal that eats *this* animal is known as the second order consumer. Scientifically, all consumers are either herbivores, carnivores, omnivores or detrivores (decomposers and other organism that break down organic matter). These 'orders' are known as trophic levels.

9.3 Decomposers

Decomposers eventually convert all organic matter into carbon dioxide (which they respire) and nutrients. This releases raw nutrients (such as nitrogen, phosphorus, and magnesium) in aa form usable to plants and algae, which incorporate the chemicals into their own cells. This process resupplies nutrients to the ecosystem, in turn allowing for greater primary production. Although decomposers are generally located on the bottom of ecosystem diagrams such as food chains, food webs, and energy pyramids, decomposers in the biosphere are crucial to the environment. By breaking down dead material, they provide the nutrients that other organisms need to survive. As decomposers feed on dead organisms, they leave behind nutrients. These nutrients become part of the soil. Therefore, more plants can grow and thrive.

9.4 Ecological pyramids

The trophic structure and function at successive trophic levels, i.e. producers - herbivores - carnivores, may be shown graphically by means of ecological pyramids where the first or producer level constitutes the base of the pyramid and the successive levels, the tiers making the apex.

The graphic expression of the trophic structure and function at successive trophic level is referred as “Ecological Pyramids”. Ecological Pyramids are of three types;

- i) Pyramid of numbers refers to number of individual organisms at eachlevel.
- ii) Pyramid of biomass refers to total dry weight of total amount of livingmatter
- iii)Pyramid of energy shows the rate of energy flow/productivity at successive energylevel

The pyramids of numbers and biomass may be upright or inverted depending upon the nature of the food chain in the particular ecosystem, whereas pyramids of energy are alwaysupright.

It shows the relationship between producers, herbivores and carnivores at successive trophic level in terms of their numbers. In grassland ecosystem, producers are maximum in number. This number then shows a decrease towards apex as the primary consumer/herbivore are

lesser in number than producers and tertiary consumers are least in number. So pyramid becomes upright. But in forest ecosystem, producers are lesser in number, which forms the base of pyramid. Herbivores - fruit/eating birds, elephants, deers etc. are more in number than producers.

In parasitic food chain, pyramids are always inverted. Number of organisms gradually shows an increase making the pyramid inverted.

9.4.1 Pyramids of Biomass

In grassland and forest ecosystems, the pyramid of biomass shows an upright position. But in ponds and other aquatic systems, producers are small organisms and biomass is also least. This value shows an increase towards the apex of the pyramid and making the pyramid inverted.

9.4.2 Pyramids of Energy

Of the three types of ecological pyramid, this energy of pyramid gives the best picture of overall nature of the system. It is a picture of the rates of passage of food mass through food chains. So its shape is always upright. Because there is always a gradual decrease in the energy content at successive trophic levels from the producers to various consumer.

Lecture: 10

10. Food Chain

A **food chain** shows how each living thing gets its food. Some animals eat plants and some animals eat other animals. For example, a simple food chain links the trees & shrubs, the giraffes (that eat trees & shrubs), and the lions (that eat the giraffes). Each link in this chain is food for the next link. A food chain always starts with plant life and ends with an animal.

1. Plants are called **producers** because they are able to use light energy from the Sun to produce food (sugar) from carbon dioxide and water.
2. Animals cannot make their own food so they must eat plants and/or other animals. They are called **consumers**. There are three groups of consumers.
 - a. Animals that eat ONLY PLANTS are called **herbivores** (or primary consumers).
 - b. Animals that eat OTHER ANIMALS are called **carnivores**.
 - carnivores that eat herbivores are called secondary consumers
 - carnivores that eat other carnivores are called tertiary consumers
e.g., killer whales in an ocean food web ... phytoplankton → small fishes → seals → killer whales

3. Animals and people who eat BOTH animals and plants are called **omnivores**.
4. Then there are decomposers (bacteria and fungi) which feed on decaying matter. These decomposers speed up the decaying process that releases mineral salts back into the food chain for absorption by plants as nutrients.

The consumer organisms are heterotrophic. Unlike the autotrophic plants, which manufacture their own food from simple inorganic chemicals, the herbivores must utilize the energy-rich compounds synthesized by the plants. In turn, the carnivores obtain energy for their metabolism when they consume the herbivores.

10.2 Food Web

There cannot be too many links in a single food chain because the animals at the end of the chain would not get enough food (and hence energy) to stay alive. Most animals are part of more than one food chain and eat more than one kind of food in order to meet their food and energy requirements. These interconnected food chains form a food web i.e. Interlocking pattern of food chain is called foodweb.

10.2.1 Ecosystems

The first steps in the evolution of agriculture were the tending of particular plant species the taming of useful animal species. The next steps were (a) domestication of these species so as to gain control of their reproduction thereby enabling selective breeding of more productive types and (b) creation of special environmental conditions which would enable these improved types to realize their higher production potential. These environmental modifications involve soil tillage, soil water management, weeding and pest control. The resulting combination of humans, domesticated plant and animal species and their modified environments is an *agro-ecosystem*, in contrast to natural ecosystems in which humans play no special role. In agro-ecosystems, the farmer is an essential ecological variable, influencing or determining the composition, functioning and stability of the system.

10.2.2 Intensive and extensive agro ecosystems

Agro-ecosystems are classifiable according to whether they are extensive or intensive. Extensive systems may be defined as those where the annual output of consumable nitrogen is less than 20 kg per ha. Outputs of crop or livestock products per unit area are low, and these outputs are dependent largely on natural soil nutrient reserves and management which conserves these reserves. Forms of subsistence agriculture such as nomadic pastoralism and shifting agriculture are widespread examples.

In intensive agro-ecosystems, very high outputs are maintained by large inputs of nutrients. Both the volume and rate of nutrient cycling are much higher than in extensive systems, particularly in

industrial agriculture. Since nutrient inputs are almost entirely in the form of inorganic fertilizers, nitrogen fixation and soil organic matter are both depressed to very low levels. Losses of nutrients from the system through exports of produce are great, while considerable leaching losses, of both soil nutrient reserves and nutrient inputs occur particularly in wetter environments when land is bare during part of the growing season.

Agro-ecosystems which involve a significant livestock sub-system as well as a cropping sub-system are known as *mixed farming* systems. They are usually intermediate in intensity between extensive and intensive agro-ecosystems.

Lecture 11

Bio-diversity: Definition, classification, threats to biodiversity and its conservation.

11. Bio-diversity

Variation is the law of nature. It occurs everywhere and every moment. The variations take place at micro levels. The variations may be linear or cyclic. The variety and variability of organisms and ecosystems is referred to as biological diversity. The world Commission on Environment and Development (WCED) constituted by the UN General Assembly published a report in 1987 which provided a boost and endorsement to the need for conserving the world's rich biodiversity. Despite conflicting views among nations, a broad consensus was reached after bitter negotiations, and 170 countries signed the Biodiversity Convention, which is now ratified by 104 countries.

Perhaps the greatest value of biodiversity is yet unknown. Scientists have discovered and named only 1.75 million species – less than 20 per cent of those estimated to exist. Of those identified, only a fraction has been examined for potential medicinal, agricultural or industrial value. Much of the earth's great biodiversity is rapidly disappearing, even before we know what is missing. Estimates vary, but the most widely accepted figure lies between 10 and 13 million species. Of these, biologists estimate that as many as 27,000 species are becoming extinct each year. This translates into an astounding 3 species every hour.

11.1 Types of Biodiversity (Diversity Indices):

Alpha (α) Diversity : Species diversity within a community or habitat, comprises two components i.e. species richness and evenness. Sometimes dominant of one vegetation stratum may affect the diversity of the other strata.

Beta (β) Diversity: β diversity is the intercommunity diversity expressing the rate of species turnover per unit

change in habitat.

Gamma(γ) Diversity: Gamma diversity is the overall diversity at landscape level includes both α and β diversities. The relationship is as follows:

$$\gamma = \alpha + \beta + Q$$

where, Q = Total number of habitats or communities, α = Average value of α diversities

β = Average value of β diversities

11.1.1 Levels of Biodiversity

Theoretically there are three levels of biodiversity.

1) Genetic diversity

It refers to the variation of genes within the species. This constitutes distinct population of the same species or genetic variation within population or varieties within a species.

2) Species diversity

It refers to the variety of species within a region. Such diversity could be measured on the basis of number of species in a region.

3) Ecological diversity

Ecological diversity is the intricate network of different species present in local ecosystem and the dynamic interplay between them. An ecosystem consists of organisms from many different species living together in a region that are connected by the flow of energy, nutrients, and matter that occurs as the organisms of different species interact with one another.

11.2 India's biodiversity

India is exceptionally rich in biodiversity and is one of the twelve mega diversity centres of the world. With 10 biogeographic zones and 25 biotic provinces, all major ecosystems are represented. India is a land mass of nearly 33 lakh sq.km with a coastline of 7,616 km and 14 different types of climatic forests and the total forest coverage in India is about 6,50,000 sq.km. India is the home land of 13,000 species of flowering plants, 20,000 species of fungi, 50,000 species of insects, 65,000 species of fauna including 2000 species of birds, 350 mammals and 420 of reptiles. It covers nearly 7% of world's flora and 6.5% of world's fauna of which 33 % flora and 62% fauna are endemic. India has over 30 National parks that constitute about 1% of the landmass and 441 sanctuaries that constitute 3.5% of the area. India is a home of over 35,000 tigers and the umbrella of project tiger 23 specially demarcated project tiger reserves covering 33,000 sq.km representing different climatic forests are spread across the country.

India has a rich and varied heritage of biodiversity, encompassing a wide spectrum of habitats from tropical rainforests to alpine vegetation and from temperate forests to coastal wetlands. **India figured with two hotspots** - the Western Ghats and the Eastern Himalayas - in an identification of 18 biodiversity hotspots carried out in the eighties. Recently, Norman Myers and a team of scientists have brought out an **updated list of 25 hotspots**. In the revised classification, the 2 hotspots that extend into India are The Western Ghats/Sri Lanka and the Indo-Burma region (covering the Eastern Himalayas); and they are included amongst the top eight most important hotspots. In addition, **India has 26 recognised endemic centres** that are home to nearly a third of all the flowering plants identified and described to date.

Of the estimated 5–50 million species of the world's biota, only 1.7 million have been described to date, and the distribution is highly uneven. About seven per cent of the world's total land area is home to half of the world's species, with the tropics alone accounting for 5 million. India contributes significantly to this latitudinal biodiversity trend. With a mere 2.4% of the world's area, India accounts for 7.31% of the global faunal total with a faunal species count of 89,451 species. Some salient features of India's biodiversity have been mentioned below.

- India has two major realms called the Palaearctic and the Indo-Malayan, and three biomass, namely the tropical humid forests, the tropical dry/deciduous forests, and the warm desert/semi-deserts
- India has ten biogeographic regions including the Trans-Himalayan, the Himalayan, the Indian desert, the semi-arid zone(s), the Western Ghats, the Deccan Peninsula, the Gangetic Plain, North-East India, and the islands and coasts.
- As of date, there are 911 properties under the World Heritage List, which cover 711 cultural sites, 180 natural sites and 27 mixed properties encompassing 152 countries, including India. India is one of the 12 centres of origin of cultivated plants.
- India's first two sites inscribed on the list at the Seventh Session of the World Heritage held in 1983 were the Agra Fort and the Ajanta Caves. Over the years, 27 more sites have been inscribed, the latest site inscribed in 2012 being the Western Ghats. Of these 29 sites, 23 are cultural sites and the other six are natural sites. A tentative list of further sites/properties submitted by India for recognition includes 33 sites.
- India has 17 biosphere reserves, and 19 Ramsar wetlands. Amongst the protected areas, India has 102 national parks and 490 sanctuaries covering an area of 1.53 lakh sq.km.
- The wildlife sanctuaries in India are home to around two thousand different species of birds, 3500 species of mammals, nearly 30000 different kinds of insects and more than 15000 varieties of plants

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11.3 Loss of Biodiversity

With the current rate of development, population growth and migration communities are increasingly unable to meet their sustained needs. However, the present day drastic changes in the environment and habitat due to population explosion and unmanaged developmental activities are so unnatural

that the species are not getting full liberty of time and space for their survival and adaptive radiation, therefore, resulting in loss of biodiversity, which is a global crisis. It is high time that our natural wealth be preserved from loss.

11.4 Threats to Biodiversity

The diversity in India i.e .forests, grass lands, wetlands, mountains, deserts and marine ecosystems face many pressures. One of the major causes for the loss of biological diversity in India has been the depletion of vegetative cover in order to expand agriculture. Since most of the biodiversity rich forests also contain the maximum mineral wealth and also the best sites for water impoundment, mining and development projects in such areas have often led to destruction of habitats. Poaching and illegal trade of wildlife products too have adversely affected biological diversity.

Causal factors of threat

Causal factors of threat may be natural or man made. They are

1. Development pressure

- Construction
- Forest based industries
- Hydel/ Irrigation projects
- Mining
- Oil drilling
- Pollution
- Resource extraction
- Road & Transport

2. Encroachment

- a. Agriculture
- b. Expansion of forest villages
- c. Fishery
- d. Grazing / increased domestic animals
- e. Habitat depletion /change
- f. New settlements
- g. Shifting cultivation

3. Exploitation

- a. Collection made by scientific/educational institutions
- b. Exploitation by local authorities as revenue resources
- c. Firewood collection
- d. Food gathering and hunting
- e. Poaching

4. Human induced disasters

- a. Floods
- b. Major oil spills/leakage

- c. Epidemics
 - d. Forestfires
- 5. Management of Naturalresources**
- a. Geneticuniformity
 - b. Inadequate water/ food forwildlife
 - c. Increasedcompetition
 - d. Introduction of exoticspecies
 - e. Predation
- 6. Management of HumanResource**
- a. Change in people'slifestyle
 - b. Increasingdemands
 - c. Dilution of traditionalvalues
 - d. Humanharassment
 - e. Inadequate trained humanresources
 - f. Lack of effectivemanagement
 - g. In appropriate landuse
- 7. Political and policyissues**
- a. Change in use / legalstatus
 - b. Civilunrest
 - c. Intercommunityconflict
 - d. Militaryactivities

Lecture 12

12.Strategies of Conservation

Future strategy for Conservation has 4 goals

1. Maintenance of adequateresources
2. Conservation of resources through reduction in demand and achievement of greater enduse
3. Maximum use of renewableresources
4. Reduction in dependency of non-renewableresources

12.1 In situ strategy

This strategy emphasizes on the conservation work at original site of biodiversity i.e. in wild. Conservation of overall diversity of genes, populations, species, communities and the ecological processes comes under this strategy. There are 37,000 protected area in the world (World Conservation Monitoring Centre , WCMC). India has 17 biosphere reserves, and 19 Ramsar wetlands. Amongst the protected areas, India has 102 national parks and 490 sanctuaries covering an

area of 1.53 lakh sq. km.

12.2 Ex situ Strategy

This strategy says that conservation work should be done outside the natural habitat in form of botanical and zoological gardens, conservation stand, seed and seedling banks, pollen banks, germ plasm banks, tissue culture banks, gene and DNA banks etc. In India, conservation of genetic diversity of cultivated plants and their wild relatives is done by NBPGR (National Bureau of Plant Genetic Resources).

12.2.1 Reduction of Anthropogenic Pressure

Increasing population and its demands pose remarkable threat to taxa important to human being. About 70% of identified medicinal plants of Indian Himalaya are exposed to destructive harvesting. Cultivation of such plants elsewhere would contribute to their conservation.

12.2.2 Restoration of endangered species

It is tough and difficult strategy. It requires specific knowledge about species and its surrounding. This strategy includes diagnosis of factors responsible for the decline of species, habitat conservation, captive breeding and restriction of harvesting etc. the strategy include:

- Reintroduction programmes in the original site of living
- Augmentation programmes to increase the existing population size and genetic diversity of a species
- Introduction programmes for a new area.
-

12.3 Important National parks and wild life sanctuaries in India

- Andhra Pradesh – Pakhal, Povharam, kawal, kollaeru, pelicanary wild life sanctuary
- Arunachal Pradesh – Namidapha Wild life sanctuaries
- Assam – Kaziranga National Park, Manas Wild life sanctuaries
- Bihar – Hazaribagh National park
- Gujarat – Gir National Park
- Karnataka – Bandipur National park, Silent Valley National park
- Kerala – Periyar Wild life sanctuarie, Wyanad Wild life sanctuarie
- Orissa – Chilka Lake Birds sanctuary
- Tamil Nadu – Mudumalai Wild life sanctuarie, Vedanthangal Bird Sanctuary
- Uttar Pradesh – Corbett National park
- West Bengal – Jaldapara Wild life sanctuarie

12.4 Some of the policies, which can be taken into account for biodiversity conservation, are:

- Identifying and monitoring the important components of biological diversity that needs to be conserved and used sustainably.
- Establishing protected areas to conserve biological diversity while promoting environmentally sound development around these areas.
- Respecting, preserving and maintaining traditional knowledge of the sustainable use of biological diversity with the involvement of indigenous peoples and local communities.
- Educating people and raising awareness about the importance of biological diversity and the need to conserve it
- Promoting public participation, particularly when it comes to assessing the environmental impacts of development projects that threaten biological diversity and protecting the biodiversity hot spots from alien species.

Biodiversity conservation is an important step towards a successful disaster management and if policies are implemented to protect it, then we can get one step closer in making a Disaster Free World.

Lecture – 13

13.Environmental pollution: Causes, effects and control of air

India today is one of the first ten industrialized countries of the world. Today we have a good industrial infrastructure in core industries like metals, chemicals, fertilizers, petroleum, food etc. what has come out of these? Pesticides, detergents, plastics, solvents, fuels, paints, dyes, food additives etc. are some examples. Due to progress in atomic energy, there has also been an increase in radioactivity in the biosphere. Besides these, there are a number of industrial effluents and emissions particularly poisonous gases in the atmosphere. Mining activities also added to this problem particularly as solid waste.

Thus, pollution is a necessary evil of all development. Due to lack of development of a culture of pollution control, there had resulted a heavy backlog of gaseous, liquid and solid pollution in our country. It is to be cleaned. Thus pollution control in our country is a recent environmental concern.

What is pollution ? Pollution is an undesirable change in the physical, chemical or biological characteristics of air, water and soil that may harmfully affect the life or create a potential health hazard of any living organism. Pollution is thus direct or indirect changes in any component of the

biosphere that is harmful to the living component(s), and in particular undesirable for man, affecting adversely the industrial progress, cultural and natural assets or general environment.

What are pollutants? Any substance which causes pollution is called a pollutant. A pollutant may thus include any chemical or geochemical (dust, sediment, grit etc.) substance, biotic component or its product, or physical factor (heat) that is released intentionally by man into the environment in such a concentration that may have adverse harmful or unpleasant effects.

13.1 Environmental Pollutants

The various principal pollutants which pollute our air, water, land are as follows :

- (1) Deposited matter – soot, smoke, tar, dust, grit etc.
 - (2) Gases – Oxides of nitrogen (NO, NO₂), sulphur (SO₂), carbon monoxide, halogens, (chlorine, bromine, iodine),
 - (3) Acids droplets – sulphuric, acid nitric acid etc.
 - (4) Fluorides
 - (5) Metals – Mercury, lead, iron, zinc, nickel, tin, cadmium, chromium etc.
 - 6) Agrochemicals – Biocides (pesticides, herbicides, fungicides, nematocides, bactericides, weedicides etc), and fertilizers.
- (1) Complex organic substances – Benzene, ether, acetic acid, benzopyrene etc.
 - (2) Photochemical oxidants – Photochemical smog, ozone, peroxyacetyl nitrate (PAN), peroxybenzoyl nitrate (PBzN), nitrogen oxides, aldehydes, ethylene etc.
 - (3) Solid wastes
 - (4) Radioactive waste
 - (5) Noise

13.2 Kinds of Pollution

Various types of pollutions are classified in different ways. On the basis of the type of environment being polluted, we may recognize air pollution, water pollution, land soil pollution, marine pollution etc. on the basis of the kind of pollutant involved, we may have sulphur dioxide pollution, fluoride pollution, carbon monoxide pollution, smoke pollution, lead pollution, mercury pollution, solid waste pollution, radioactive pollution, noise pollution etc. Of the variety of pollutants, we recognize the following two basic types of pollutants: non degradable and

biodegradable.

13.2.1 Nondegradable pollutants

These are the materials and poisonous substances like aluminium cans, mercuric salts, long-chain phenolics, DDT etc. that either do not degrade or degrade only very slowly in nature. They are not cycled in ecosystem naturally but by subsequent movement in food chains and biogeochemical cycles.

13.2.2 Biodegradable pollutants

They are the domestic wastes that can be rapidly decomposed under natural condition. They may create problems when they accumulate (i.e. their input into the environment exceeds their decomposition).

Atmosphere

The earth's vertically extended atmosphere, an envelope of gases is divided into the following layers : (i) troposphere (up to 5 km) – the lowest atmosphere in which temperature decreases with height bounded by land or sea surface below and by tropopause above, (ii) stratosphere (5 to 45 km) - the region above the troposphere, in which temperature increases up to 90⁰C with height. This is limited by stratopause, (iii) mesosphere (45 to 80 km) – the part between stratosphere and thermosphere (ionosphere). Temperature again decreases up to – 80⁰C. (iv) thermosphere (ionosphere) – above 80 km, the upper part in which temperature increases with height. There is no boundary between the atmosphere and void of outer space. About 75% of the earth's atmosphere lies within 16 km. of the surface and 99% of the atmosphere lies below an altitude of 30 km.

Normal composition of clean air at or near sea (1990) is as follows:

Gases	Percent (by Volume)
Nitrogen	78.084
Oxygen	20.9476
Argon	0.934

Carbon dioxide	0.0314
Methane	0.0002
Hydrogen	0.00005

Lecture – 14

14. Air Pollution

It is defined as the excessive concentration of foreign material in the atmosphere, which affects the health of individuals and also causes damage to the property.

Air pollution episodes

London smog: $\text{SO}_2 \rightarrow \text{H}_2\text{SO}_3$ vapours in the atmosphere. When automobile exhausts are trapped by this smog and exposed to sunlight, it produces photochemical smog.

Bhopal gas tragedy: The poisonous gas, methyl isocyanate (MIC) leakage in the pesticide manufacturing plant of Union Carbide of India Ltd., (UCIL), Bhopal, Madhya Pradesh on December 3, 1984. 46 tons of MIC was released spreading to 40 km. *Effects*: About 65,000 people suffered from various disorders in eyes, lungs, stomach, heart, etc. The immediate symptom is bronchospasm which causes coughing, chest pain and abdominal pain. Nearly 3000 people died within a short span of time, 1600 domestic animals died and crop yields were reduced.

Darkening effect of Taj Mahal

Taj Mahal is a white marble stone mausoleum. Recently it was observed that the walls of Taj Mahal has become darkened and disfigured due to air pollution from nearby Mathura Oil refinery.



The acid rain reacts with marble stone (CaCO_3) to produce calcium sulphate, causing darkening and disfigurement.

14.1 Types, sources and effects of air pollution

Air pollution may be simply defined as the presence of certain substances in the air in high enough concentrations and for long enough duration to cause undesirable effects. "Certain substances" may be any gas, liquid or solid, although certain specific substances are considered significant pollutants

because of very large emission rates are harmful and unwanted effects. “Long enough durations” can be anywhere from a few hours to several days or weeks; on a global scale, durations of months and years are of concern.

14.1.1 Sources

Air pollution results from gaseous emission from mainly industry, thermal power stations, automobiles, domestic combustion etc.

1. **Industrial chimney wastes:** There are a number of industries which are source of air pollution. Petroleum refineries are the major source of gaseous pollutants. The chief gases are SO_2 and NO_x . Cement factories emit plenty of dust, which is potential health hazard. Stone crushers and hot mix plants also create a menace. Food and fertilizers industries which emit gaseous pollutants. Chemical manufacturing industries which emit acid vapours in air.
2. **Thermal power stations:** There are a number of thermal power stations and super thermal power stations in the country. The National thermal power corporation (NTPC) is setting up four mammoth coal-powered power stations to augment the energy generation. These are at Singrauli in U.P., Korba in M.P., Ramagundam in Andhra Pradesh and Farakka in W. Bengal. The coal consumption of thermal plants is several million tones. The chief pollutants are fly ash, SO_2 and other gases and hydrocarbons.
3. **Automobiles:** The toxic vehicular exhausts are a source of considerable air pollution, next only to thermal power plants. The ever increasing vehicular traffic density posed continued threat to the ambient air quality. Chief sources of emission in automobiles are (i) exhaust system, (ii) fuel tank and carburettor and (iii) crankcase. The exhaust produces many air pollutants including unburnt hydrocarbons, CO, NO_x and lead oxides. There are also traces of aldehydes, esters, ethers, peroxides and ketones which are chemically active and combine to form smog in presence of light. Evaporation from fuel tank goes on constantly due to volatile nature of petrol, causing emission of hydrocarbons. The evaporation through carburettor occurs when engine is stopped and heat builds up, and as much as 12 to 40 ml of fuel is lost during each long stop causing emission of hydrocarbons.

14.1.2 Sources of indoor air pollution

- Combustion (to heat water, cook and space heating) can produce elevated levels of CO and NO_x.
- Certain photocopying machines emit ozone.
- Formaldehyde emissions from particle board, plywood, urea – formaldehyde foam insulation.
- Asbestos used for fireproofing and insulation.
- Various volatile organics emitted from household cleaning products.
- Many pollutants, such as cigarette smoke and radon when emitted indoors can be concentrated, leading to harmful exposure levels.
- Tobacco smoke contains numerous known or suspected carcinogens, including benzene, hydrazine, benzo - a - pyrene (BaP) and Nickel.
- Smoke particles are small, averaging about 0.2 μm, so they are easily carried into the deepest regions of the lungs.
- A single cigarette smoke gives off on the order of 10¹² smoke particles, most of which are released while the cigarette is simply smoldering in the air (*sidestream smoke*) rather than when a smoker takes a puff (*mainstream smoke*).
- Hence non smokers are also exposed to significant amount of smoke particles.
- Other indoor air pollutants arising from tobacco smoke include carbon monoxide, nicotine, nitrosamines, acrolein and other aldehydes.
- Another potentially important source of indoor air pollution is caused by wood-burning stoves and fireplaces.
- Wood combustion produces CO, NO_x, hydrocarbons and respirable particles and some emissions that are suspected carcinogens like benzo - a - pyrene.

14.2 Effects of air pollution

Air pollution is known to have many adverse effects, including those on human health, building facades and other exposed materials, vegetation, agricultural crops, animals, aquatic and terrestrial ecosystems, and the climate of earth as a whole.

a) Health effects

Perhaps the most important effect of air pollution is the harm it causes to human health. Generally, air pollution is most harmful to the very old and the very young. Many elderly people may already suffer from some form of heart or lung disease, and their weakened condition can make them very susceptible to additional harm from air pollution. The sensitive lungs of new

born infants are also susceptible to harm from dirty air. But it is not just the elderly or the very young who suffer; healthy people of all ages can be adversely affected by high levels of air pollutants. Major health effects are categorized as being acute, chronic, or temporary.

b)Effect onMaterials

Every year , air pollutants cause damage worth billions of rupees. Air pollutants breakdown the exterior paint in cars and houses. Air pollutants have discolored irreplaceable monuments, historic buildings, marble statues and other heritage and natural beauty sites.

c) Effect on plants.

Some gaseous pollutants enter leaf pores and damage the crop plants. Chronic exposure of leaves to air pollutants damages waxy coating, leads to damage from diseases, pests, drought and frost. Such exposure interferes with photosynthesis and plant growth, reduces nutrient uptake and causes leaves to turn yellow, brown or drop off. At higher concentrations of SO₂ most of the flower buds become stiff and hard and fall off. Prolonged exposure to higher levels of air pollutants from Iron smelters, coal burning power plants and industries, vehicles can damage trees and plants.

d) on Stratosphere

Ozone is continuously being created in the stratosphere by the absorption of short-wavelength UV radiation, while at the same time it is continuously being removed by various chemical reactions that convert it back to molecular oxygen. The rates of creation and removal at any given time and location dictate the concentration of ozone present. The balance between creation and removal is being affected by increasing stratospheric concentrations of chlorine, nitrogen and bromine, which acts as catalysts, speeding up the removal process. CFCs are predominant.

14.3 Management of Air Pollution

For ages man has been dumping wastes into the atmosphere, and these pollutants have disappeared with the wind. We have seen that the main sources of air pollution are (i) motor vehicles,

(ii) industries-particularly their chimney wastes, (iii) fossil-fuel (coal) based plants, as thermal power plants. Steps are to be taken to control pollution at source (prevention) as well as after the release so pollutants in the atmosphere. There is an urgent need to prevent the emissions from the above said major sources of air pollution. The control of emissions can be realized in number of ways

Lecture - 15

Global warming and climate change: GHG emission, GH effect, impact on environment and agriculture – mitigation strategies, Ozone depletion and Acid Deposition

Air pollution problems are not necessarily confined to a local or regional scale. Atmospheric circulation can transport certain pollutants far away from their point of origin, expanding air pollution to continental or global scales; it can truly be said that air quality problems know no international boundaries. Some air pollutants are known to be associated with changes in Earth's climate, requiring consideration of governmental actions to limit their impacts. Two important air pollution problems that are generally considered worldwide in scope are **global warming** and **depletion of stratospheric ozone**.

15.Greenhouse Gases

Since CO₂ is confined exclusively to the troposphere, its higher concentration may act as a serious pollutant. Under normal conditions (with normal CO₂ concentration) the temperature at the surface of the earth is maintained by the energy balance of the sun rays that strike the planet and heat that is radiated back into space. However, when there is an increase in CO₂ concentration, the thick layer of this gas prevents the heat from being re-radiated out. This thick CO₂ layer thus functions like the glass panels of a greenhouse (or the glass windows of a motor car), allowing the sunlight to filter through but preventing the heat from being re-radiated in outer space. This is the so-called greenhouse effect. Nitrogen and oxygen, the main constituents of the atmosphere, play no part in the green house effect. But there are approximately 35 trace gases that scientists believe contribute to global warming. **Carbon dioxide (CO₂)** is considered to be one of the most important of these greenhouse gases, absorbing most of the heat trapped by the atmosphere.

Other gases of special importance in global warming are **chlorofluorocarbons (CFCs)**, **methane**, **nitrous oxide** and **ozone**. Although the average concentrations of these gases are much lower than that of carbon dioxide, they are much more efficient than carbon dioxide at soaking up long – wave radiation. Overall, carbon dioxide is estimated to cause almost 60 per cent of the warming effect and CFCs about 25 per cent, and the remainder is caused by methane, nitrous oxide, ozone, and other trace gases.

More than 80% of the mass of the atmosphere and virtually all of water vapour, clouds and precipitation occur in the troposphere. Earth's surface, it consists of *troposphere*, *stratosphere*, *mesosphere* and the *thermosphere*. Troposphere extends upto 10-12 km at mid latitudes (at equator – 18 km, at poles 5-6 km). In troposphere, temperatures typically decrease at 5-7°C per km (wet adiabatic lapse rate).

15.1 Equilibrium temperature increase caused by CO₂

- Considerable effort has gone into attempting to quantify the relationship between expected global temperature change and CO₂ concentration.
- Typical of current understanding is that a doubling of CO₂ will likely result in an eventual global warming of approximately 1.5–4.5°C.
- An increase of only 1.5°C over the pre industrial temperature would make the earth warmer than it has been in the last 10,000 years.
- In the past 100 years or so, an increase of 0.5°C has actually occurred in the global average surface temperature.
- Elevated temperatures increase evaporation, increasing the amount of water vapour in the air. Since water vapour is a green house gas, it might cause even more warming. On the other hand, increased cloudiness may increase the albedo. Increasing albedo would lead to global cooling.

15.1.1 CHLOROFLUOROCARBONS

- CFCs are mainly used as refrigerants, solvents, foaming agents in the production of rigid and flexible foams and as aerosol propellants for such products as deodorants, hairspray and spraypaint.
- Chlorofluorocarbons (CFCs) are molecules that contain chlorine, fluorine and carbon.
- As opposed to other greenhouse gases, CFCs do not occur naturally and their presence in the atmosphere is due entirely to human activities.
- CFCs absorb strongly in the atmospheric window (7-12 μm) and tend to have long atmospheric residence times. Hence they are potent greenhouse gases.
- The two CFCs that have received the most attention, in both ozone and climate change contexts are trichlorofluoromethane, CFCl₃(CFC-11), and dichlorofluoromethane, CF₂Cl₂(CFC-12).
- CFC molecules are inert and non-water soluble, so they are not destroyed through chemical reactions or removed with precipitation.
- The only known removal mechanism is photolysis by short wavelength solar radiation, which occurs after the molecules drift into the stratosphere. The chlorine freed during this process can go on to destroy stratospheric ozone.
- CFCs are mainly used as refrigerants, solvents, foaming agents in the production of rigid and flexible foams and as aerosol propellants for such products as deodorants, hairspray and spraypaint.
- Some of the CFCs are based on a one-carbon methane structure, such as trichlorofluoromethane(CFCl₃) and dichlorofluoromethane(CF₂Cl₂), they were often referred as *chlorofluoromethanes* or *CFMs*. The DuPont trade name freon has also been used.
- When molecules contain only fluorine, chlorine and carbon, they are called *fully halogenated CFCs*.
- Some CFCs contain hydrogen as well as chlorine, fluorine and carbon and they are called

hydrochlorofluorocarbons or HCFCs.

- HCFCs have the environmental advantage that, due to the hydrogen bond, they are less stable in the atmosphere and hence, are less likely to reach the stratosphere to affect the ozone layer. The ozone depleting potential of HCFCs is only 2-5% compared most commonly used CFCs. The most widely used CFCs are CFC –11, CFC –12 and CFC–113.
- When no chlorine is present in the molecule, they are called *hydrofluorocarbons or HFCs*. HFCs are important replacements for CFCs, since their lack of chlorine means they do not threaten the ozone layer.

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16. OTHER GREENHOUSE GASES

- **Methane** is a naturally occurring gas that is increasing in concentration, as a result of human activities.
- It is produced by bacterial fermentation under anaerobic conditions, such as in swamps, marshes, rice paddies, as well as in the digestive systems of ruminants and termites.
- It is also released during the production, transportation and consumption of fossil fuels, as well as when biomass fuels are burned.
- After its release, methane is thought to have an atmospheric residence time of around 8-11 years. It is eventually removed through oxidation with various OH radicals.
- Methane concentrations have increased rapidly in the past 20 years and correlate quite well with human population size.
- **Nitrous oxide** is another naturally occurring greenhouse gas that has been increasing in concentration due to human activities.
- It is released into the atmosphere mostly during the nitrification portion of the nitrogen cycle NH_4^+ □ N_2 □ N_2O □ NO_2^- □ NO_3^-
- Combustion of fossil fuels and nitrogen fertilizer consumption are thought to be the two most important human activities leading to increases in nitrous oxide levels.
- It apparently has no significant tropospheric sinks and is only slowly degraded in the stratosphere by photolysis.
- The destruction process in the stratosphere involves a reaction with atomic oxygen leading to formation of nitric oxide, which in turn reacts catalytically with ozone.
- The desired removal of nitrous oxide, then, has the undesired effect of reducing stratospheric ozone.
- Nitrous oxide has an extremely long residence time of 150 years in the atmosphere. It has strong absorption bands at 4.5, 7.8 and 17 μm and it is thought to be about 230 times as potent as CO_2 in causing global warming.
- **Ozone** plays an important role in both troposphere and stratosphere.
- About 90% of atmospheric ozone resides in the stratosphere and it protects life by

absorbing short- wavelength ultraviolet radiation.

- Stratospheric ozone also affects climate, but in a very complex way. Incoming solar energy is absorbed, which heats the stratosphere. This, however, reduces the radiation arriving at the earth's surface, thereby cooling the surface.
- On the other hand, the warmed stratosphere radiates energy back to the earth's surface, thereby heating it. The net effect is uncertain.
- In the troposphere, ozone is a component of photochemical smog and it poses a serious health problem.
- Tropospheric ozone absorbs strongly at around $9.6 \mu\text{m}$, right in the middle of the atmospheric window. Increasing concentrations could contribute to raising global temperatures.
- Ozone, however, has a rather short residence time in the troposphere, measured in days. It is irregularly distributed by time of day, geographic location, and altitude. So it has been difficult to assess its overall change with time, leaving us uncertain as to its impact on climate.

16.1 The Greenhouse effect

- Nearly all the incoming solar energy arrives extra terrestrially, with wavelength less than $4 \mu\text{m}$ (short wavelength radiation), while the outgoing energy radiated by the earth has essentially all of its energy in wavelength greater than $4 \mu\text{m}$ (long wavelength or thermal radiation)
- Essentially all the incoming solar radiation with wavelengths less than $0.3 \mu\text{m}$ (ultraviolet) is absorbed by oxygen and ozone in the stratosphere.
- Most of the long wave-length energy radiated by the earth is affected by a combination of radiatively active gases, most importantly water vapour (H_2O), CO_2 , N_2O and CH_4 .
- Radiatively active gases that absorb wavelengths longer than $4 \mu\text{m}$ are called *greenhouse gases*.
- These gases trap most of the outgoing thermal radiation attempting to leave the earth's surface. This absorption heats the atmosphere, which, in turn, radiates energy back to the earth as well as out to space.
- The greenhouse effect adds 33°C of warming to the surface of the earth, i.e., if there was no greenhouse effect, the earth would have an average temperature of -18°C or about 0°C .
- Distributed over the entire surface of the earth, the incoming solar radiation is equal to $343 \text{W}/\text{m}^2$.
- Since the albedo is 30% ($103 \text{W}/\text{m}^2$), the amount of incoming radiation absorbed by the atmosphere and earth is $240 \text{W}/\text{m}^2$.
- Of that $240 \text{W}/\text{m}^2$, $86 \text{W}/\text{m}^2$ are absorbed by the atmosphere and the remaining $154 \text{W}/\text{m}^2$ are absorbed by the surface of the earth.

16.2 Global Warming and Climate Change

Carbon dioxide is a green house gas that is confined to the troposphere and its higher concentration may act as a serious pollutant. Under normal conditions the temperature at the surface of the earth is maintained by energy balance of the sun rays that strike the planet and heat that is reradiated back into space. However when there is an increase in

CO₂ concentration, the thick layer of the gas prevents the heat from being reradiated out. This thick CO₂ layer functions like the glass panel of a green house, allowing the sun light to filter through but preventing the heat from being reradiated into outer space. Therefore, it is warmer inside the green house than outside. Similar condition is resulted in the troposphere of the earth and termed as '**Green house effect**'.

Carbon dioxide concentration of the troposphere has been increasing steadily due to industrial growth. Nearly hundred years ago the CO₂ concentration was 275 ppm, today it is 350 ppm and by the year 2040 it is expected to reach 450 ppm. Certain gases in the atmosphere, known as 'green house' gases like CO, CO₂, CH₄ are able to absorb and emit heat. When sunlight strikes the earth's surface it warms up, emits heat, which radiates upwards into space. This heat warms up the green house gases so that they also emit heat, some into space and some back down to earth, which results in heating up of the earth atmosphere, also known as **Global warming**.

16.3 Acid deposition/Acid rain

The presence of excessive acid in rain water is called Acid rain. It is a mixture of nitric acid, sulphuric acid and carbonic acid. Since the early 1970s, problems associated with acidic precipitation have gained worldwide attention. Acid rain have damaged or destroyed fish and plant life in thousands of lakes throughout central and northern Europe (especially in Scandinavia), the north east United States, south east Canada, and parts of China. Many species of trees in forests throughout these regions have been in decline, largely due to soil acidification. Acid rain also causes pitting and corrosion of metals and the deterioration of painted surfaces, concrete, limestone, and marble in buildings, monuments, works of art, and other exposed objects.

Acid rain is caused by the emission of sulfur and nitrogen oxides into the atmosphere, mostly from the burning of fossil fuels for electric power. Other sources from human activities include certain industrial processes and the gasoline powered automobile. Sulfur dioxide reacts with water vapor in the air to form sulfuric acid; nitrogen dioxide reacts with water vapor to form nitric acid. It has been found that the contribution of sulfur dioxide to acid rainfall is more than twice that from nitrogen oxides. Contribution of these gases from natural sources, such as from swamps and volcanoes, are small in comparison to human sources. A major environmental impact of acid deposition is the lowering of pH in lakes and rivers. Most aquatic life is disrupted as the pH drops. Phytoplankton populations are reduced, and many common water – dwelling invertebrates, such as may flies and stone flies, cannot survive when the pH falls below about 6.0. Some sensitive species of fish, including trout and salmon, are harmed when pH levels fall below 5.5. Acidity has a deleterious effect on the reproductive cycle of fish; when the pH is less than 4.9, reproduction of most fish species is unlikely. Acid dead lakes have pH below about 3.5.

17. Causes, effects and control of water and marine pollution.

Water is one of the most important commodities which Man has exploited than any other resource for sustenance of his life. Most of the water in this planet is stored in oceans and ice caps which is difficult to be recovered for our diverse needs. It can be said that no water is pure or clean owing to the presence of some quantities of gases, minerals and life. Pure water is considered to be that which has low dissolved and suspended solids and obnoxious gases as well as low biological life. Water can be regarded polluted when it changes its quality or composition either naturally or as a result of human activities, thus becoming less suitable for drinking, domestic, agricultural, industrial, recreational, wildlife and other uses.

Some pollutants can be formed by way of concentrations and transformations of naturally occurring compounds during their domestic, agricultural or industrial use. The generation of sewage and the waste waters containing agrochemicals, certain pesticides and surfactants, petrochemicals, hydrocarbons, heavy metals and radionuclides are some important examples of pollutants originated in this way.

17.1 Sources of Water Pollutants

To understand the effects of water pollution and the technology applied in its control, it is useful to classify pollutants into various groups or categories. Water pollutant can be classified according to the nature of its origin as either a **point source** or a **dispersed source pollutant**.

A **point source** pollutant is one that reaches the water from a pipe, channel or any other confined and localized source. The most common example of a point source of pollutants is a pipe that discharges sewage into a stream or river. Most of these discharges are treatment plant effluents.

A **dispersed or non point source** is a broad, unconfined area from which pollutants enter a body of water. Surface runoff from agricultural areas carries silt, fertilizers, pesticides, and animal wastes into streams, but not at only one particular point. These materials can enter the water all along a stream as it flows through the area. Acidic runoff from mining areas is a dispersed pollutant. Storm water drainage systems in towns and cities are also considered to be dispersed sources of many pollutants, because, even though the pollutants are often conveyed into streams or lakes in drainage pipes or storm sewers, there are usually many of these discharges scattered over a large area.

Point source pollutants are easier to deal with, while pollutants from dispersed sources are much more difficult to control. Many people think that sewage is the primary culprit in water pollution problems, but dispersed sources cause a significant fraction of the water pollution. The most effective way to control the dispersed sources is to set appropriate restrictions on land use.

17.1.1 Effects of Water Pollution

1. Physicochemical effects

A large number of pollutants can impart colour, tastes and odours to the receiving waters, thus making them unaesthetic and even unfit for domestic consumption. The changes in oxygen, temperature and pH affect the chemistry of waters often triggers chemical reactions resulting in the formation of unwanted products. The addition of organic matter results in depletion of oxygen with concomitant increase in carbon dioxide owing to bacterial degradation.

2. Biological effects

The addition of pollutants leads to the shift in flora and fauna due to homeostatic factors operating in the aquatic systems. Most of the freshwater algae are highly sensitive to pollutants and their elimination modifies the prey-predatory relationships by breaking down the food chains. This results in the change of the whole plant and animal communities. The diversity of organism decrease due to the presence of only a few tolerant forms in the polluted conditions.

The first response to the added nutrients is increased algal growth which is often composed of obnoxious bloom forming blue-green or green chlorophycean algal forms. Many of the blue- greens are not consumed by predators and some even produce toxic secretions causing allelopathic effects (e.g., *Microcystis* spp.)

3. Toxic effects

These are caused by pollutants such as heavy metals, biocides, cyanide and other organic and inorganic compounds which are detrimental to the other organisms. These substances usually have very low permissible limits in water and their presence beyond limits can render the water unfit for aquatic biota and even for human use

These chemicals are toxic to aquatic organisms, and many of them especially those non-biodegradable, accumulate in the body of the organisms and biomagnify along the trophic levels causing long term effects.

4. Pathogenic effects

Besides the chemical substances, a few wastes like sewage, also contain several pathogenic and nonpathogenic microorganism and viruses. The *Clostridium perfringens* and *Streptococcus faecalis* cause various types of food poisoning. Apart from this, many water borne diseases like cholera, typhoid, paratyphoid, colitis, and infective hepatitis (jaundice) are spread by consumption of sewage contaminated waters.

5. Eutrophication

One of the most severe and commonest water pollution problems is due to enrichment of waters by plant nutrients that increases the biological growth and renders the water bodies unfit for diverse uses. The process of increase in the nutrients of waters and resultant spurt in algal productivity is called *eutrophication*.

17.1.2 Control of Water pollution

Raw or untreated sewage comprises about 99.9 per cent water and only about 0.1 per cent impurities. In contrast to this, sea water is only about 96.5 per cent pure water; it contains about 35,000 mg/L, or 3.5 per cent dissolved impurities. Although sea water contains more impurities than does sanitary sewage, we do not ordinarily consider seawater to be polluted. The important distinction is not the total concentration, but the type of impurities. The impurities in seawater are mostly inorganic salts, but sewage contains biodegradable organic material, and it is very likely to contain pathogenic microorganisms as well. Actually, sewage contains so many different substances, both suspended and dissolved, that it is impractical to attempt to identify each specific substance or microorganisms. The total amount of organic materials is related to the strength of the sewage. This is measured by the biochemical oxygen demand, or BOD. Another important measure or parameter related to the strength of the sewage is the total amount of suspended solids, or TSS. On the average, untreated domestic sanitary sewage has a BOD of about 200 mg/L and a TSS of about 240 mg/L. Industrial wastewater may have BOD and TSS values much higher than those for sanitary sewage; its composition is source dependent.

Another group of impurities that is typically of major significance in waste water is the plant nutrients. Specifically, these are compounds of nitrogen and phosphorous. On the average, raw

Waste water treatment

These treatment methods are grouped into three general categories: **primary** treatment, **secondary or biological** treatment and **tertiary or advanced** treatment.

Primary Treatment

Untreated or raw wastewater usually flows by gravity from an interceptor or trunk sewer into the head works of a treatment facility; sometimes wastewater may be pumped to the treatment plant in a force. The head works of a treatment plant include a flow measurement device and mechanical systems that provide preliminary treatment. Preliminary treatment systems typically include screens, comminutors, and gritchambers.

Grit removal

A portion of the suspended solids in raw sewage consists of gritty material, such as sand, coffee grounds, eggshells, and other relatively inert material. In cities with combined sewer systems, sand and silt may be carried in the sewage. Suspended grit can cause excessive wear and tear on pumps and other equipment in the plant. Most of it is non biodegradable and will accumulate in treatment tanks. For these reasons, a grit removal process is usually used after screening and / or comminuting.

Primary sedimentation (Settling)

After preliminary treatment by screening, comminuting, and grit removal, the wastewater still contains suspended organic solids that can be removed by plain sedimentation. Settling tanks that receive sewage after grit removal are called primary clarifiers. The combination of preliminary screening and gravity settling is called primary treatment. Chemicals may sometimes be added to the primary clarifiers to promote the removal of very small (or colloidal) particles. Primary treatment usually can remove up to 60 per cent of the suspended solids and about 35 per cent of the BOD from wastewater, but this relatively low level of treatment is no longer adequate. In almost all cases, primary treatment must be followed by secondary treatment processes; tertiary treatment may also be required to protect sensitive bodies of water that receive the treated effluent.

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18. Marine Pollution

The marine water represents a different kind of habitat for microorganisms. The very vastness of the oceans and the variety of microbial life present in these make the study of these a special branch of microbiology called marine microbiology. The marine water contains algae, protozoa, yeasts, moulds, bacteria and viruses. The microorganisms which are free - floating are collectively known as the plankton and may consist of algae (phytoplankton) and protozoa and minute animals (zooplankton). Bacteria and fungi may also form part of the plankton. The algae are the primary producers as they can photosynthesize while others are consumers at various levels of the food - chain. The microorganisms found at the bottom of the ocean are called the benthos or benthic microorganisms. A variety of microorganisms are found in the benthic region but the bacteria predominate.

In polluted areas of estuarine regions rich in organic nutrients, organisms such as *Beggiatoa*, *Thiothrix*, *Thiovolum* and various species of *Thiobacillus* may be predominant. The transient bacteria may include species of *Bacillus*, *Corynebacterium*, *Sarcina*, *Actinomyces* and Gram - negative *vibrio* - like organisms. A terminally bisporous species of *Clostridium* which is unique to the ocean is named *Clostridium oceanicum*. Photosynthetic purple sulphur bacteria usually occur below algal mats in anaerobic environs, as most of the light and oxygen is absorbed by algae.

In polluted waters, there are large amounts of organic matter from sewage, feces and industrial complex. The microbes are usually heterotrophic. The digestion of organic matter by these organisms is incomplete, due to which they accumulate acids, bases, alcohols and various gases. The major types of bacteria are coliform bacteria, the Gram-negative nonspore forming bacilli usually found in the intestine. This group includes *E. coli* and species of *Enterobacter*. They ferment lactose to acid and gas. Noncoliform bacteria - *Streptococcus*, *Proteus* and *Pseudomonas* are also present.

Under some conditions, the polluting organisms multiply rapidly and consume most of the available oxygen. For instance, nutrients enter the river from sources like sewage treatment plants or urban/suburban runoff. Thus river suddenly develops a high nutrient content. Under these conditions algae may bloom rapidly. This leads to depletion of oxygen in water. There is very little oxygen available to the protozoa, small animals, fish and plants. Due to this non-availability of oxygen, a layer

of dead organisms, mud and silt accumulate at the bottom and anaerobic species of *Clostridium*, *Desulfovibrio* etc. will flourish and they produce gases. One gas, H₂S combines with lead or iron to give a precipitate which makes the mud black and the water poisonous. Due to complete depletion of oxygen, the suspended bacteria die in their own waste products. There is hardly any life in water at this stage. The gas bubbles from the anaerobes in the mud break the surface and such processes lead to death of river.

All that what is carried by rivers ultimately ends up in the seas. On their way, rivers receive huge amounts of sewage, garbage, agricultural discharge, biocides, including heavy metals. These all are added to sea. Besides these discharge of oils and petroleum products and dumping of radionuclides waste into sea also cause marine pollution. Huge quantity of plastic is being added to sea and oceans. Over 50 million Ib plastic packing material is being dumped in sea of commercial fleets.

The pollutants in sea may become dispersed by turbulence and ocean currents or concentrated in the food chain. They may sediment at the bottom by processes like adsorption, precipitation and accumulation. Bioaccumulation in food chain may result into loss of species diversity.

18.1 Marine pollution

It is defined as the discharge of waste substances into the sea, posing threat to living sources, hazard to human health, hindrance to fishery and impairment of quality of sea water. Marine pollution is associated with the change in physical, chemical and biological conditions of the sea water. Nearly 71% of Earth surfaces is covered with Oceans, which comprise a total of approximately 1.37 x 10³⁹ litres. Ocean is an ideal place to dump all the manwastes.

18.1.1 Marine pollutants in the sea.

- Pathogens
- Sediments
- Solidwastes
- Heat
- Freshwater
- Brine
- ToxicInorganics
- ToxicOrgnics
- Pertroleum andoil
- Nutrients
- Radioactivematerials
- Oxygen demandingmaterials
- Acids andBases

These pollutants comes from various sources. The Marine pollution may also off natural origin.

18.1.2 Sources of pollutants

- Marine commerce
- Industry
- Electrical Power generation
- Sewage treatment
- Other Non Industrial Wastes
- Recreation
- Construction

Oil Spills – Oil pollution of the sea normally attracts the greatest attention because of its visibility.

Weathering

- Modifying physical and chemical properties
- Oil floating- spreading to a wide spectrum of the area
- Crude oil forms sticky layers- prevents free diffusion of gases, decreases the photosynthesis
- Volatile components- evaporate, heavy tar ball- assimilated by bottom organisms

Evaporation

- Series of chemical and physical changes that cause spilled oil to break down and become heavier than water
- Winds, waves, and currents may result in natural *dispersion*, breaking a slick into droplets
- These droplets may also result in the creation of a secondary slick or thin film on the surface of the water

Oxidation

- Occurs when the lighter substances within the oil mixture become vapors
- Leaves heavier components of the oil, which may sink to the ocean floor. Spills of kerosene and gasoline contain a high proportion of flammable components (evaporate completely within a few hours)
- Reducing the toxic effects to the environment.
- Heavier oils leave a thicker, more viscous residue, which may have serious physical and chemical impacts on the environment
- Wind, waves, and currents increase both evaporation and natural dispersion

Biodegradation

- Occurs when microorganisms feed on oil
- To sustain biodegradation, nitrogen and phosphorus are added to encourage the microorganisms to grow and reproduce
- Biodegradation tends to work best in warm water environments

Emulsions

- Emulsions consisting of a mixture of small droplets of oil and water
- Emulsions are formed by wave action, and greatly hamper weathering and cleanup processes

- Two types of emulsions exist: water-in-oil and oil-in-water
- Water-in-oil emulsions are frequently called "chocolate mousse," - formed strong currents or wave action makes water trapped inside the viscous oil
- Oil and water emulsions cause oil to sink

Spreading

- Initially as a single slick depends upon the viscosity of the oil
- Fluid, low viscosity oils spread more quickly than those with a high viscosity
- Slicks quickly spread to cover extensive areas of the sea surface
- Spreading is rarely uniform and large variations in the thickness of the oil

Dispersion

- Waves and turbulence at the sea surface cause all or part of a slick to break up into fragments and droplets of varying sizes
- Oil that remains suspended in the water has a greater surface area than before dispersion occurred
- Encourages other natural processes (dissolution, biodegradation and sedimentation to occur)
- Speed of oil disperses is largely dependent upon the nature of the oil and the sea state
- Quick if the oil is light and of low viscosity and if the sea is very rough.

Sedimentation/Sinking

- Heavy refined products have densities greater than one, so sink in fresh or brackish water
- Sea water has a density of approximately 1.025 and very few crudes are dense enough or weather sufficiently
- Sinking usually occurs due to the adhesion of particles of sediment or organic matter to the oil

Lecture: 19

Causes, effects and control of soil pollution

19. Soil Pollution

Soil is the loose and unconsolidated outer layer of earth's crust that is powdery in nature and made up of small particles of different sizes. Soil ecosystem includes inorganic and organic constituents, and the microbial groups. Soil microorganisms are the active agents in the decomposition of plant and animal solid wastes and said to be nature's garbage disposal system. The soil microbes keep our planet earth free of unwanted waste materials and recycle the elements (C, N, and P) through mineralization. Soil microbes decompose a variety of compounds, cellulose, lignin, hemicellulose, proteins, lipids, hydrocarbons etc. The soil microbial community has little or no action on many man-made synthetic polymers. The persistent molecules that fail to be metabolized or mineralized have been termed as recalcitrants

Fertilizer pollution

The agricultural production depends on chemical fertilizer application, as most of our high yielding varieties are fertilizer responsive. Continuous application of chemical fertilizers alone lead to deterioration of soil properties and cultivated soils lose their natural characteristics. Fertilizers like ammonium sulphate, ammonium chloride and urea reduce the soil pH. Many crops, like potato, grapes, citrus, beans are sensitive to chloride toxicity. In integrated nutrient management, to sustain the productivity of our soils, organic manures and bio fertilizers are recommended as supplements to chemical fertilizers.

Nitrate pollution

Nitrogen occurs in many forms in the environment and takes part in many biochemical reactions. The four forms of nitrogen that are of particular significance in environmental technology are organic nitrogen, ammonia nitrogen, nitrite nitrogen, and nitrate nitrogen. In water contaminated with sewage, most of the nitrogen is originally present in the form of complex organic molecules (protein) and ammonia (NH_3). These substances are eventually broken down by microbes to form nitrites and nitrates.

Excess Salts and Water

Irrigation water helps to produce more yield than rain fed land. Irrigation water contains dissolved salts and in dry season, water in the form of saline solution evaporates leaving its salts such as NaCl in the top soil. This saline soil causes stunted plant growth, lower yield. Flushing out salts reduces the salinity but makes downstream irrigation water, saltier. Another problem is waterlogging.

Heavy metal pollution

Heavy metals include all metals with atomic numbers greater than 23 (with few exceptions) or more than 5 gm per ml. (eg. Hg, 70 gm ml⁻¹). Heavy metals are hazardous, not acceptable to biological system. They are toxic to man and other life forms. Most of them are slow poisons as they accumulate in the body and cause serious disorders. Mercury, lead, arsenic, chromium and cadmium are the five most common toxic heavy metals and they have serious effects on human health

Industrial Wastes: Indiscriminate dumping of untreated or inadequately treated domestic, mining and industrial wastes on and is an important source of soil pollution. Fall out of gaseous and particulate air pollutants from mining and smelting operations, smoke stacks etc. are the major source of soil pollutants in nearby areas.

Urban Wastes : Millions of tones of urban waste are produced every year from polluted cities. The inadequately treated or untreated sewage sludge not only poses serious health hazards but also pollutes soil and decreases its fertility and productivity. Other waste materials such as rubbish, used plastic bag, garbage sludge, dead animals, hospital wastes, skins, tyres shoes etc. cause land and soil pollution. Suspended matter present in sewage can act as a blanket on the soil and interfere with its

productivity.

Plastics

Plastics form a major part of global domestic and industrial waste. Not being biodegradable, waste plastic accumulates, adding to pollution. Using photodegradable plastic or biodegradable plastic can solve plastic pollution problem. Photodegradable plastic contains an element sensitive to UV rays. Under the effect of solar rays the element is activated and breaks the polymeric chain of the photodegradable plastic. It results in small fragments that are easily digested by microbes.

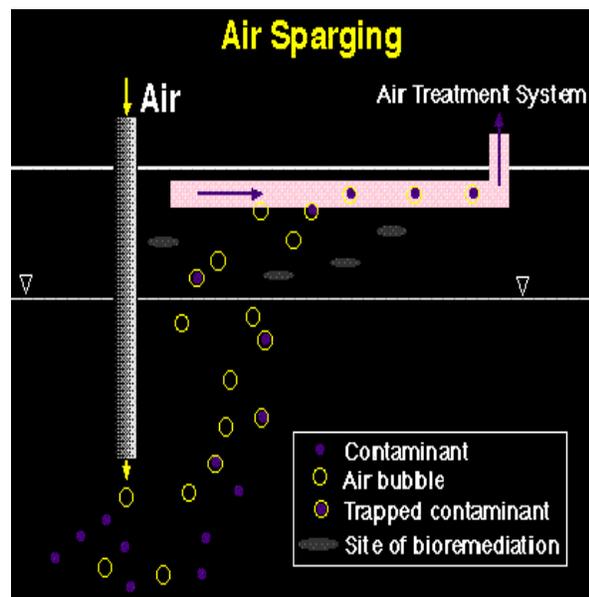
Lecture: 20

20. Control of Soil Pollution

Soil may be polluted and converted into acidic soil or alkaline soil. It should be corrected by suitable technology, before cultivation

20.1 Methods of Soil treatment

Air sparging is an *in situ* remedial technology that reduces concentrations of volatile constituents in petroleum products that are adsorbed to soils and dissolved in groundwater. This technology, which is also known as "*in situ* air stripping" and "*in situ* volatilization," involves the injection of contaminant-free air into the subsurface saturated zone, enabling a phase transfer of hydrocarbons from a dissolved state to a vapor phase. The air is then vented through the unsaturated zone. Air sparging is most often used together with soil vapor extraction (SVE), but it can also be used with other remedial technologies.



Soil washing is a water-based process for scrubbing soils *ex situ* to remove contaminants. The process removes contaminants from soils in one of the following two ways:

- By dissolving or suspending them in the wash solution (which can be sustained by chemical manipulation of pH for a period of time);or

- By concentrating them into a small volume of soil through particle size separation, gravity

20.1.1 Soil conservation

Soil conservation is the protection of soil against excessive loss of fertility by natural, chemical, or artificial means. It encompasses all management and land-use methods protecting soil against degradation, focusing on damage by erosion and chemicals. Soil conservation techniques can be achieved through crop selection and rotation, fertilizer and lime application, tillage, residue management, contouring and strip cropping, and mechanical methods (e.g., terracing).

1. Agronomic practices
2. Dry farming
3. Agrostological methods

20.1.2 Soil Amelioration

1. Soil Amelioration

Amelioration of Acidic Soil: Soil acidity is due to the accumulation of H^+ ions over OH^- ions. Limiting material – are neutralization of H^+ ions such as

- *Quicklime*- oxide of lime is usually known as burned lime or quicklime.
- *Slaked lime*- can be obtained by adding water to quicklime.
- *Blast furnace slag*- a byproduct during the manufacture of pig iron viz, calcium silicate.
- *Basic Slag*- is a byproduct of the basic open heart method of producing steel from pig iron,
- *Electric furnace slag*- is produced from the electric furnace reduction of phosphate rock during preparation of phosphorous. The product is mainly the calcium silicate.

Amelioration of Saline and Alkali Soil

Saline soil- they contain an excess of soluble salts. *Saline soil reclamation can be achieved by:*

- Providing proper drainage
- Using salt free irrigation water
- Use of acidic fertilizers- such as ammonium sulphate
- Use of organic fertilizers
- Use of organic manures.

Alkaline soil- they contain appreciable amounts of soluble salts. *Alkali soil reclamation* may be achieved by the following practices:

- Application of gypsum
- Use of sulphur
- Addition of organic matter
- Addition of molasses.

2. Prevention of solid waste dumping

Open dumping of solid waste should be segregated and recyclable materials could be recycled. Other garbage can be converted into organic manure by suitable technology.

3. Usage of bio-fertilizers and bio-pesticides.

4. Following the concept of Integrated Plant Nutrient System (IPNS).

Lecture: 21

Causes, effects and control of noise and thermal pollution.

21. Noise pollution

Noise is perhaps one of the most undesirable by products of modern mechanized lifestyle. It may not seem as insidious or harmful as the contamination of drinking water supplies from hazardous chemicals, but it is a problem that affects human health and well-being and that can also contribute to the general deterioration of environmental quality. It can affect people at home, in their community, or at their place of work.

Sound waves cause eardrums to vibrate, activating middle and inner organs and sending bioelectrical signals to the brain. The human ear can detect sounds in the frequency range of about 20 to 20,000 Hz, but for most people hearing is best in the range of 200 to 10,000 Hz. A sound of 50 Hz frequency, for example, is perceived to be very low-pitched, and a 15,000 - Hz sound is very high pitched.

Simply defined, noise is undesirable and unwanted sound. It takes energy to produce sound, so, in a manner of speaking, noise is a form of waste energy. It is not a substance that can accumulate in the environment, like most other pollutants, but it can be diluted with distance from a source. All sounds come from a sound source, whether it be a radio, a machine, a human voice, an airplane, or a musical instrument. Not all sound is noise. What may be considered music to one person may be nothing but noise to another. To a extent, noise pollution is a matter of opinion. Noise is measured in terms of Decibel units.

21.1 Sources of noise

Based on the type of noise include

- a) Industrial Noise
- b) Transport Noise
- C) Neighbourhood Noise

Industrial Noise

It is caused by machines used for the technological advancement. There exist a long list of sources of noise pollution including different machines of numerous factories, industries and mills.

Transport Noise:

Main source is transport. In addition to adversely impacting urban air quality, heavy automobile traffic creates seemingly unbearable noise pollution. Ever since industrial revolution doubling of noise for every 10 years



Pointed nose that angles downward during takeoff, the Anglo-French Concorde flies at more than twice the speed of sound. Supersonic plane is very noisy, and some believe its sonic booms harm the environment.



Animals such as whales use water to communicate with one another over great distances. Human-generated noises in the ocean, such as engine noises by boats, may interfere with animal communication.



21.1.1 Intensity of Noise sources

Sources	Intensity(dB)
Breathing	10
Trickling clock	20-30

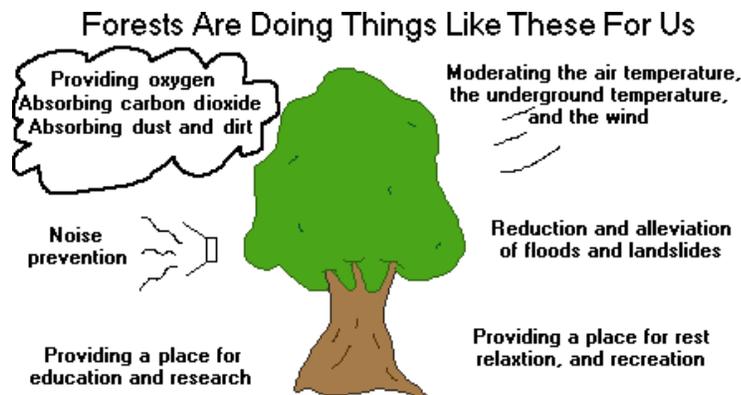
Normal conversation	35-60
Office noise	60 - 80
Traffic	50-90
Motor cycle	105
Jet fly	100 - 110

21.1.2 Control of Noise Pollution

Noise definitely affects the quality of life. It is therefore important to ensure the mitigation or control of noise pollution. Noise pollution can be controlled

- At source level – Can be done by i) Designing and fabricating silencing devices in air craft engines, automobiles industrial machines and home appliances, ii) By segregating the noisy machines
- During Transmission – can be achieved by adding insulation and sound-proofing to doors, around industrial machinery. Zoning urban areas to maintain a separation between residential areas and zones of excessive noise.
 - a) Acoustillite : made up of Compressed wood pulp, wood fibers and is available in the form of tiles
 - b) Acoustical blanket : Prepared from mineral wool or glass fibres
 - c) Hair Felt: Consists of wool fibres, Coarse Cotton Fibres.
 - d) Fibre Glass
 - e) Cork Carpet: Prepared out of pieces of corks treated with linseed oil and is used for covering floors.
 - f) Acoustic Plaster: Mainly consists of gypsum in the form of plaster.
- Protecting the exposed person
- By creating vegetation cover – Plants absorb and dissipate sound energy and thus act as Buffer Zone. Trees should be planted along highways, schools and other places.

Planting vegetation to absorb and screen out noise pollution – Trees can act as a noise barrier



- Through law

- a) Silence Zones must be created near Schools,hospitals
- b) Indiscriminate use of loudspeakers at public places should be banned/restricted bylaws
- c) Restriction on unnecessary use of horns and vehicles plying without silencers
- d)

Lecture:22

22. Thermal Pollution

The term thermal pollution has traditionally been used more often to refer to the heating of lakes, river, streams, and other water bodies usually by electric power generating plants or by factories

- The combustion of fossil fuels always produces heat, sometimes as a primary desired product, and sometimes as a secondary, less desired by-product i.e.noise
- Heat is also produced when fossil fuels are burned to generate electricity. In this case, heat is a by-product, not the main reason that fuels are burned.
- Electricity is also generated in nuclear power plants, when no combustion occurs.
- The decay of organic matter in landfills also releases heat to the atmosphere.

It is clear, therefore, that a vast array of human activities result in the release of heat to the environment. As those activities increase in number and extent, so does the amount of heat released. In many cases, heat added to the environment begins to cause problems for plants, humans, or other animals. This effect is then known as *thermal pollution*.

22.1 Sources of Thermal pollution

- Coal fired power plant effluents
- Domestic sewage
- Hydroelectric power effluent
- Industrial effluents
- Nuclear power plants

22.1.1 Effects of thermal Pollution

A one megawatt nuclear power plant may require 1.3 billion gallons (five million m³) of cooling water each day. The water used in such a plant has its temperature increased by about 63°F (17°C) during the cooling process. For this reason, such plants are usually built very close to an abundant water supply such as a lake, a large river, or the ocean.



When thermal pollution drives water temperatures up, most aquatic and marine wildlife cannot survive. Immobile organisms, such as plants and shellfish, simply die. One inevitable

result of thermal pollution is a reduction in the amount dissolved oxygen in water. The amount of any gas that can be dissolved in water varies inversely with the temperature. As water is warmed, therefore, it is capable of dissolving less and less oxygen. Organisms that need oxygen to survive will, in such cases, cant be able to survive.

When heated water is released from a plant or factory, it does not readily mix with the cooler water around it. Instead, it forms a stream- like mass known as a thermal plume that spreads out from the outflow pipes. It is in this thermal plume that the most severe effects of thermal pollution are likely to occur. Only over an extended period of time does the plume gradually mix with surrounding water, producing a mass of homogenous temperature



22.1.2 Control of Thermal pollution

The water heated by thermal pollution also has a number of potential useful applications. For example, it may be possible to establish aquatic farms where commercially desirable fish and shellfish can be raised. The Japanese have been especially successful in pursuing this option. Some experts have also suggested using this water to heat buildings, to remove snow, to fill swimming pools, to use for irrigation, to de-ice canals, and to operate industrial processes that have modest heat requirements. Hot water is pumped into one end of the pond and cooler water is removed from the other end. The heat gets dissipated from the pond into the atmosphere. The main disadvantage is large amounts of water are lost due to evaporation

Here at Westport, Kentucky the Ohio River provides the large amount of water required by this coal-fired power plant. Thermal pollution is abated by the use of the large cooling tower which emits only steam into the atmosphere.

Lecture: 23

23. Causes, effects and management of nuclear hazards and industrial wastes.

The spontaneous emission of particles and rays by an unstable nucleus is called Radioactivity and such substances are called Radioactive Substances eg. Radium, Uranium, Thorium. Radioactive pollution can be defined as the release of radioactive substances or high-energy particles into the air, water, or earth as a result of human activity, either by accident or by design. Sometimes natural sources of radioactivity, such as radon gas emitted from beneath the ground, are considered pollutants when they become a threat to human health. The sources of Radioactive wastes are

- 1) Natural sources: Solar radiation, Radionuclides in the earth Crust, Human Internal

radiation, environmentalRadiations.

- 2) Anthropogenic Sources: The sources of such waste include : 1) nuclear weapon testing or detonation; 2) the *nuclear fuel cycle*, including the mining, separation, and production of nuclear materials for use in nuclear power plants or nuclear bombs; (3) accidental release of radioactive material from nuclear powerplants..

Since even a small amount of radiation exposure can have serious (and cumulative) biological consequences, and since many radioactive wastes remain toxic for centuries, radioactive pollution is a serious environmental concern even though natural sources of radioactivity far exceed artificial ones are present. The faster a radioisotope is decaying, the more radioactive it will be. Another factor in deciding how dangerous a pure radioactive substance will be is the energy of the radiation. Some decays yield more energy than others. This is further complicated by the fact that few radioisotopes decay immediately to a stable state, but rather to a radioactive decay product leading to decay chains.

Radioactive pollution that is spread through the earth's atmosphere is termed *fallout*. Such pollution was most common in the two decades following World War II, when the United States, the Soviet Union, and Great Britain conducted hundreds of nuclear weapons tests in the atmosphere. France and China did not begin testing nuclear weapons until the 1960s and continued atmospheric testing even after other nations had agreed to move their tests underground.

Three types of fallout result from nuclear detonations: local, tropospheric and stratospheric.

- Local fallout is quite intense but short-lived.
- Tropospheric fallout (in the lower atmosphere) is deposited at a later time and covers a larger area, depending on meteorological conditions.
- Stratospheric fallout, which release extremely fine particles into the upper atmosphere, may continue for years after an explosion and attain a world wide distribution.

23.1 Types of radioactive waste:

Low level Waste (LLW) is generated from hospitals and industry, as well as the nuclear fuel cycle. It comprises paper, rags, tools, clothing, filters etc which contain small amounts of mostly short-lived radioactivity. It does not require shielding during handling and transport and is suitable for shallow land burial. To reduce its volume, it is often compacted or incinerated before disposal.

Intermediate level Waste (ILW) contains higher amounts of radioactivity and some requires

shielding. It typically comprises resins, chemical sludges and metal fuel cladding, as well as contaminated materials from reactor decommissioning. It may be solidified in concrete or bitumen for disposal. Generally short lived waste (mainly from reactors) is buried in a shallow repository, while long lived waste (from fuel reprocessing) will be disposed of deep underground.

Transuranic Waste arises mainly from weapons production, and consists of clothing, tools, rags, residues, debris and other such items contaminated with small amounts of radioactive elements -- mostly plutonium. These elements have an atomic number greater than uranium -- thus transuranic (beyond uranium). Because of the long half-lives of these elements, this waste is not disposed of as either low level or intermediate level waste. It does not have the very high radioactivity of high level waste, nor its high heat generation. The United States currently permanently disposes of transuranic waste at the Waste Isolation Pilot Plant.

High level Waste (HLW) arises from the use of uranium fuel in a nuclear reactor and nuclear weapons processing. It contains the fission products and transuranic elements generated in the reactor core. It is highly radioactive and hot. It can be considered the "ash" from "burning" uranium. HLW accounts for over 95% of the total radioactivity produced in the process of nuclear electricity generation.

Waste Stored Safely Now

- After it is removed from the reactor, used fuel is stored at nuclear plant sites in steel-lined, concrete vaults filled with water.
- The water cools the used fuel and acts as a shield, to protect workers from radiation.
- This used fuel looks just like it did when it was placed in the reactor.
- The radioactive waste remains locked inside the uranium pellets, which are still encased in the metal fuel rods.

Effect of Radioactive wastes

Radioactive waste causes

- Soil pollution
- Water pollution

In these two pollutions, pollution hazards finally enter into the food chain the human who is the final victim of radioactive pollution as he is at the end of all reactions and interactions.

Effects of radioactive pollution:

The effect of radioactive pollution depends upon

- ✓ Half-life
- ✓ Energy releasing capacity
- ✓ Rate of diffusion
- ✓ Rate of deposition of the contaminant.
- ✓ Various atmospheric and climatic conditions such as wind, temperature, rainfall also determine their effects.

23.1.1 Control of Radioactive pollution

The main objective in managing and disposing of radioactive (or other) waste is to protect people and the environment. This means isolating or diluting the waste so that the rate or concentration of any radionuclides returned to the biosphere is harmless. To achieve this for the more dangerous wastes, the preferred technology to date has been deep and secure burial. Transmutation, long-term retrievable storage, and removal to space have also been suggested.

- Nuclear devices should never be exploded in air. If these activities are extremely necessary they should be exploded underground.
- In nuclear reactions, closed-cycle coolant system with gaseous coolants of very high purity may be used to prevent extraneous activation products.
- In nuclear and chemical industries, the use of radio-isotopes may be carried under a set of soil or water instead of power or gaseous forms.
- In Nuclear mines, wet drilling may be employed along the underground drainage.
- Nuclear reactors must be enclosed in broad concrete walls to prevent the radiations that emerge out.
- Workers should wear protective garments and glass spectacles should be screened from radiation.
- Extreme care should be exercised in the disposal of industrial waste contaminated with radionuclides. The spent rods are very radioactive containing about 1% U 235 and 1% plutonium.

Lecture: 24

24. Effects of industrial effluents

Industries need a wide variety of raw materials and chemicals which are later discharged as effluents. Acids, alkalis, toxic metals, pesticides and other poisonous substances such as cyanide, dyes, oils, detergents, resins, rubbers are a few to mention. Heated effluents that impart thermal

loading on receiving waters and effluents containing radio active materials are also of prime concern. Some of the

effluents such as from tanning and meat packing may also contain pathogenic bacteria. The nature and extent of pollution depends on the materials present in the effluent and on the quantity discharged.

24.1 Effects on water courses

Color :The effluents contain dyes in higher concentrations which impart color to the receiving streams and they persist for longer distances. Photosynthesis of phytoplankton is affected by these colors.

pH value : The extreme alkalinity makes the receiving water unfit for any purpose. Further, it is deleterious to most of the aquatic life.

Suspended impurities :The colloidal and suspended impurities produce turbidity in the receiving waters. The turbidity and color along with the oil and scum create an unsightly appearance.

Depletion of oxygen :Natural substances such as starch and dextrin and inorganic substances such as sulfide and nitrite present in the effluent exert an immediate oxygen demand. The stream will then be devoid of oxygen and the aquatic life are affected adversely.

Toxic substances :Chromium, sulfide, chlorine and aniline dyes present in these wastes are directly toxic to fish and microbial organisms which carryout purification. Thus the self purification of the water body is affected.

Oils :Various oils (mineral) in the effluent interfere with the oxygenation of stream as they form a blanket on the surface and prevents the entry of oxygen at air/water interface.

Dissolved minerals :The mineral materials, mostly sodium salts increase the salinity of the water and consequently it becomes unfit for irrigation.

24.1.1 Effects on land

1. The excess content of sodium (60%) and boron (2 mg/l) are deleterious to crops.
2. The high sodium alkalinity combined with salinity impairs the growth of plants.
3. Texture of the soil is affected by sodium and penetration of roots is prevented.
4. Soil permeability is also affected by sodium and ultimately the soil will lose its productivity.

5. Suspended and colloidal impurities clog the pores and form a mat on the surface of soil preventing the passage of air, water etc.

Lecture: 25

25. Disaster management, Floods, earthquakes, cyclones and land slides.

Disaster is a sudden, calamitous event bringing great damage, loss, destruction and devastation to life and property. The damage caused by disaster is immeasurable and varies with the geographical location, climate and the type of the earth surface. This influences the mental, socio-economic, political and cultural state of the affected area. Generally, disaster has the following effects in the concerned areas,

1. It completely disrupts the normal day to day life
2. It negatively influences the emergency systems
3. Normal needs and processes like food, shelter, health, etc. are affected and deteriorate depending on the intensity and severity of the disaster.

It may also be termed as “a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected society to cope using its own resources.”

25.1 Types of Disaster

Generally, disasters are of two types – **Natural** and **Manmade**. Based on the devastation, these are further classified into major/minor natural disaster and major/minor manmade disasters. Some of the disasters are listed below,

Major natural disasters:

- Flood
- Cyclone
- Drought
- Earthquake

Minor natural disasters:

- Cold wave
- Thunderstorms
- Heat waves
- Mudslides
- Storm

Major manmade disaster:

- Setting offires
- Epidemic
- Deforestation
- Pollution due to prawn cultivation
- Chemical pollution.
- Wars

Minor manmade disaster:

- Road / train accidents, riots
- Food poisoning
- Industrial disaster/crisis
- Environmental pollution

25.1.1 Disaster Management

There are no standardized rules defining the different phases of the disaster management cycle. Different agencies use different cycles depending upon their objectives. However, while approaches vary, it is agreed that disaster management activities should be carried out in a cycle. The following figures illustrates the phases of the disaster management cycle, which are described as follows:



The Disaster Management Cycle

25.1.2 Disaster prevention, mitigation and preparedness

The first important steps towards reducing disaster impact are to correctly analyse the potential risk and identify measures that can prevent, mitigate or prepare for emergencies. Information and Communication Technology can play a significant role in highlighting risk areas, vulnerabilities and potentially affected populations by producing geographically referenced analysis through, for example, a geographic information system (GIS). The importance of timely disaster warning in mitigating negative impacts can never be underestimated. For example, although damage to property cannot be avoided, developed countries have been able to reduce loss of life due to disasters much more effectively than their counterparts in the developing world. A key reason for this is the implementation of effective disaster warning systems and evacuation procedures used by the developed countries, and the absence of such measures in the developing world.

25.1.3 Disaster Warning

Disaster Reduction identifies several key parties that play major roles in the disaster management process, especially in disaster warning **Communities**, particularly those most vulnerable, are vital to people-centred early warning systems. Their input into system design and their ability to respond ultimately determine the extent of risk associated with natural hazards. Communities should be aware of hazards and potential negative impacts to which they are exposed and be able to take specific actions to minimize the threat of loss or damage. As such, the geographic location of a community is an essential determinant in the selection of disasters on which the system should focus their community education. For example, coastal communities need to be educated and prepared for the possibility of a tsunami, while a mountain community can be educated to respond to an early warning system for landslides.

Local governments should have considerable knowledge of the hazards to which their communities are exposed. They must be actively involved in the design and maintenance of early

warning systems, and understand information received to be able to advise, instruct or engage the local population in a manner that increases their safety and reduces the potential loss of resources on which the community depends.

National governments are responsible for policies and frameworks that facilitate early warning, in addition to the technical systems necessary for the preparation and issuance of timely and effective hazard warnings for their respective countries. They should ensure that warnings and related responses are directed towards the most vulnerable populations through the design of holistic disaster response and early warning frameworks that address the specific needs of the related micro- and macro-level actors. The provision of support to local communities and local governments to develop operational capabilities is an essential function to translate early warning knowledge into risk reduction practices.

Regional institutions and organizations should provide specialized knowledge and advice in support of national efforts to develop or sustain the operational capabilities of countries that share a common geographical environment. Regional organizations are crucial to linking international capabilities to the particular needs of individual countries and in facilitating effective early warning practices among adjacent countries.

International bodies should provide support for national early warning activities and foster the exchange of data and knowledge between individual countries. Support may include the provision of advisory information, technical assistance, and policy and organizational support necessary to ensure the development and operational capabilities of national authorities or agencies responsible for early warning practice.

Non-governmental organizations (NGOs) play a critical role in raising awareness among individuals and organizations involved in early warning and in the implementation of early warning systems, particularly at the community level. In addition, they play an important advocacy role to help ensure that early warning stays on the agenda of government policy makers.

The private sector has a diverse role to play in early warning, including developing early warning capabilities in their own organizations. The private sector is also essential as they are usually better equipped to implement Information and Communication Technology-based solutions. The private sector has a large untapped potential to help provide skilled services in the form of technical manpower, know-how, or donations of goods or services (in-kind and cash), especially for the

communication, dissemination and response elements of early warning.

The media plays an important role in improving the disaster consciousness of the general population and in disseminating early warnings. The media can be the critical link between the agency providing the warning and the general public.

The scientific community has a critical role in providing specialized scientific and technical input to assist governments and communities in developing early warning systems. Their expertise is critical to analysing the risks communities face from natural hazards, supporting the design of scientific and systematic monitoring and warning services, fostering data exchange, translating scientific or technical information into comprehensible messages, and disseminating understandable warnings to those at risk.

25.1.4 Channels Used for

Disaster Warning Radio

and Television

Considered the most traditional electronic media used for disaster warning, radio and television have a valid use. The effectiveness of these two media is high because even in developing countries and rural environments where the tele-density is relatively low, they can be used to spread a warning quickly to a broad population. The only possible drawback of these two media is that their effectiveness is significantly reduced at night, when they are normally switched off.

Telephone (Fixed and Mobile)

Telephones can play an important role in warning communities about the impending danger of a disaster.

Short Message Service

Short message service (SMS) is a service available on most digital mobile phones that permits the sending of short messages (also known as ‘text messages’, ‘SMSes’, ‘texts’ or ‘txts’) between mobile phones, other handheld devices and even landline telephones.

Satellite Radio

A satellite radio or subscription radio is a digital radio that receives signals broadcast by communications satellite, which covers a much wider geographical range than terrestrial radio signals. Satellite radio functions anywhere there is line of sight between the antenna and the satellite, given there are no major obstructions such as tunnels or buildings. Satellite radio audiences can follow a single channel regardless of location within a given range. Satellite radio can play a key role during both disaster warning and disaster recovery phases. Its key advantage is the ability to work even outside of areas not covered by normal radio channels. Satellite radios can also be of help when the transmission towers of the normal radio station are damaged in a disaster.

Internet/Email

The role Internet, email and instant messages can play in disaster warning entirely depends on their penetration within a community and usage by professionals such as first responders, coordinating bodies, etc. While these media can play a prominent role in a developed country, where nearly half of all homes and almost all offices have Internet connections, this is not the case in the developing world. In many developing countries, less than 5 percent of the population uses the Internet and even those who are users do not use it on a regular basis. In such a situation, it is difficult to expect Internet and email to play any critical role.

Lecture: 26

26. The use of GIS in different phases Planning

Locating and identifying potential problems is a core requirement in disaster management. GIS can be used effectively to achieve this objective. Using a GIS, it is possible to pinpoint hazard trends and start to evaluate the consequences of potential emergencies or disasters. When hazards are viewed with other map data, such as buildings, residential areas, rivers and waterways, streets, pipelines, power lines, storage facilities, forests, etc., disaster management officials can formulate mitigation, preparedness, response and possible recovery needs.

26.1 Mitigation

After potential emergency situations are identified, mitigation needs can be addressed. This process involves analysing the developments in the immediate aftermath of a disaster, evaluating the damage and determining what facilities are required to be reinforced for construction or relocation purposes. Mitigation may also include implementing legislation that prevents building structures in areas prone to earthquake, flood or tsunami. Other mitigation approaches may target fire-safe roofing materials in wildfire hazard areas. Utilizing existing databases linked to geographic features in GIS makes the task of monitoring these possible.

26.1.2 Preparedness

During the preparedness and response phases, GIS can accurately support better response planning in areas such as determining evacuation routes or locating vulnerable infrastructure and vital lifelines, etc. It also supports logistical planning to be able to provide relief supplies by displaying previously available information on roads, bridges, airports, railway and port conditions and limitations. Apart from this, activities such as evacuee camp planning can also be done using GIS.

26.1.3 Disaster response

The most difficult period of a disaster is the immediate aftermath. This period calls for prompt action within an exceptionally short period of time. In the aftermath of any disaster, a significant number of individuals will be injured and/or displaced. Many of them may still be living with the trauma they have encountered, including loss of loved ones. Affected individuals may also be without food or other essential items. They might be waiting in temporary shelters, with no idea what to do next. Some might need immediate medical attention, while the disaster aftermath environment also creates ideal breeding grounds for possible epidemics.

- Tracing Missing Persons
- Coordinating Donor Groups
- Recording the Locations of Temporary Camps and Shelters

26.1.4 Disaster recovery

Disaster reconstruction has to start as soon as the initial disaster cleanup has taken place. This is a very complex endeavour, requiring a huge array of skill sets and a thorough knowledge of an ever-increasing variety of techniques and equipment. A range of software tools are being used for these purposes. Thus, while the role of Information and Communication Technology in the long-term disaster recovery process is not as apparent as it is in disaster warning, there is no doubt that

Information and Communication Technology is being used widely to expedite these activities.

26.2 Disaster management in India

The **National Disaster Management Authority** (NDMA), headed by the Prime Minister of India, is the Apex Body for Disaster Management in India. The setting up of the NDMA and the creation of an enabling environment for institutional mechanisms at the State and District levels is mandated by the Disaster Management Act, 2005.

Evolution of NDMA

Emergence of an organization is always an evolutionary process. Establishment of NDMA has also gone through the same processes. Towards this aim, the Government of India (GOI), in recognition of the importance of Disaster Management as a national priority, has set up a High-Powered Committee (HPC) in August 1999 and also a nation committee after the 2001 Gujarat earthquake, for making recommendations on the preparation of Disaster Management plans and suggestion effective mitigation mechanisms. The Tenth Five-Year Plan Document also had, for the first time, a detailed chapter on Disaster Management. Similarly, the Twelfth Finance Commission of India was also mandated to review the financial arrangements for Disaster Management. On 23 December 2005, the Government of India enacted the Disaster Management Act, which envisaged the creation of the National Disaster Management Authority (NDMA), headed by the Prime Minister of India, and State Disaster Management Authorities (SDMAs) headed by respective Chief Ministers of the States, to spearhead and implement a holistic and integrated approach to Disaster Management in India.

Lecture: 27

27.Floods

A flood is an expanse of water submerging land. A flood is caused by excess water in a location, usually due to rain from a storm or thunderstorm or the rapid melting of snow. A flood happens when an area of land, usually low-lying, is covered with water. The worst floods usually occur when a river overflows its banks. The flood is constituted not only of the overflowing water but also of all other waters that are unable to drain off into waterchannels.

27.1 Causes of floods

- 1) When snow on a mountain melts or when a river or a lake of some sort overflows

- 2) Flooding from water displacement, such as in a landslide,
- 3) The failure of a dam,
- 4) An earthquake induced tsunami,
- 5) A hurricane's storm surge or melt water from volcanic activity.
- 6) Flooding of Coastal areas by high tides or by tsunami waves caused by undersea earthquakes.
- 7) A flood that rises and falls rapidly with little or no advance warning is called a flash flood. Flash floods usually result from intense rainfall over a relatively small area.

27.1.1 Elements at risk

- 1) Buildings built of earth (mud), weak foundation and water soluble material.
- 2) Basement of buildings.
- 3) Utilities such as sewerage, water supply.
- 4) Agricultural equipment and crops, vehicles, fishing boats etc.

27.1.2 Effects of flood

- Physical damage- structures such as buildings get damaged due to flood water. Landslides can also take place. Top soil gets washed away
- Casualties - people and livestock die due to drowning. It can also lead to epidemics and diseases.
- Water supplies- Contamination of water. Clean drinking water becomes scarce.
- Crops and food supplies- shortage of food crops can be caused due to loss of entire harvest.

27.1.3 Flood management

Flood management involves the following activities:

- 1) **Mapping**- of the flood prone area.
- 2) **Land use control**- no major development should be permitted in the areas subjected to flooding.
- 3) **Construction of engineered structures**- strong structures to withstand flood forces. Moreover the buildings should be constructed on an elevated area and if necessary should be built on stilts.
- 4) **Flood control**- it aims to reduce flood damage. It includes:
 - a) Flood reduction

- b) Flooddiversion
- c) Floodproofing

Forexample,

- London is protected from flooding by a huge mechanical barrier across the river Thames, which is raised when the water level reaches a certain point.

Notable floods

- Jakarta on January 2007 till now is having a 1.5 M flood. whole city is affected. 80 people killed.
- The floods in peninsular Malaysia, Sabha and Sumithra in December 2006 and January 2007 is considered to be the worst in 100 years, resulting in evaluation of over 100,000 people in the worst-hit state of Johor at its peak.
- Ethiopia saw one of its worst floods in August 2006.

27.2 Cyclone

The name cyclone was first coined by Captain Henry Piddington, Chairman of Marine Court, Calcutta in 1848. It is derived from Greek word means coil of a snake. Cyclone is an meteorological phenomena in which an area of low pressure characterized by inward spiraling winds that rotate counter clockwise in the northern hemisphere and clockwise in the southern hemisphere of the earth. Near the places of their origin they are only 80 Km in diameter, but well developed cyclones have their diameter ranging from 300 to 1500 km. They move at faster rate over the oceans than over the land because the irregularities of the land surface retard their speed. The six main types of cyclones are polar cyclone, polar low, extra tropical, subtropical, tropical and mesoscale.

While moving over the ocean, they pick up energy from the warm water of the ocean and some of them grow into a devastating intensity. On an average, about 5-6 tropical cyclones form in the Bay of Bengal and the Arabian sea every year, out of which 2-3 may be severe.

Depending on their location and strength, there are various terms by which tropical cyclones are known, such as hurricane, typhoon, tropical storm, cyclonic storm and tropical depression. They are all cyclonic storm systems that form over the oceans. Tropical cyclones can produce extremely strong winds, tornadoes, torrential rain, high waves, and storm surges. The heavy rains and storm surges can produce extensive flooding. Although one cannot control cyclones, the effects of cyclones can be mitigated through effective mitigation policies and strategies.

- Installation Of Earth Warning Systems :Such systems fitted along the coastlines can greatly assist forecasting techniques, thus helping in early evacuation of people in the storm surge areas.
- Developing communication infrastructure Amateur Radio has today emerged as second line unconventional communications systems and is an important tool for disaster mitigation.
- Developing shelter belts: Shelter belts with plantations of trees can act as effective wind-and tide-breakers. Apart from acting as effective windbreakers and protecting soil crops from being damaged, they also prevent soil erosion.
- Developing community cyclone shelters: Cyclone shelters at strategic locations can help in minimizing the loss of human life. In the normal course of life, these shelters can be used as public utility buildings.
- Construction of permanent houses: There is a need to build appropriately-designed concrete houses that can withstand high winds and tidal waves.
- Training and education: Public awareness programs that inform the population about their response to cyclone warnings and preparedness can go a long way in reducing casualties.
- Land use control and settlement planning: Ideally, no residential and industrial units should be permitted in the coastal belt of 5 km from the sea, as it is the most vulnerable belt. No further growth of settlements in this region should be permitted. Major settlements and other important establishments should be located beyond 10 km from the sea.

Lecture: 28

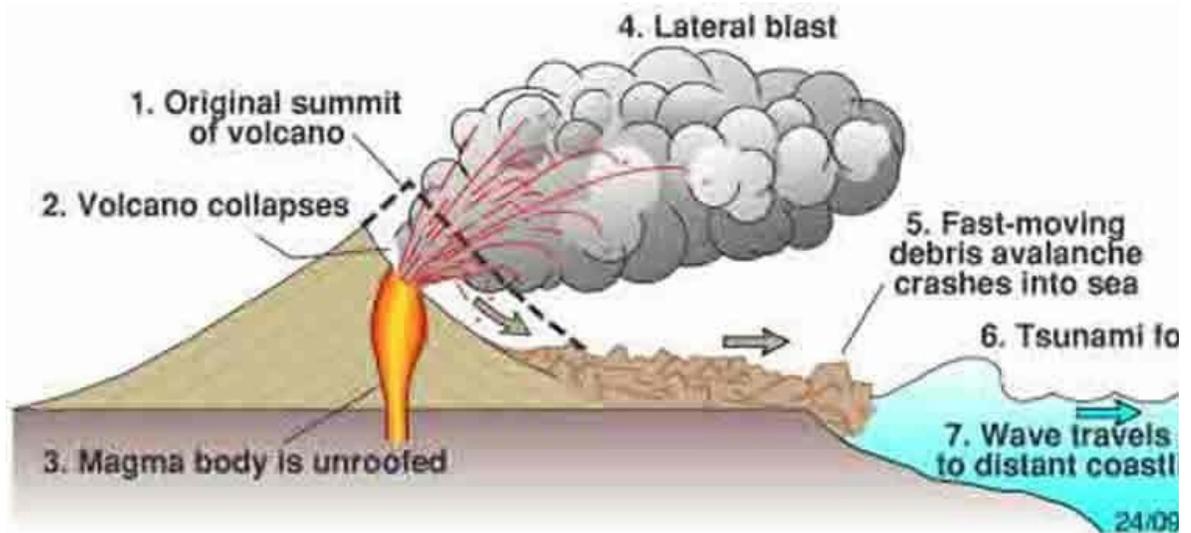
28. Earthquakes and Mitigation Measures

Earthquake is those movements of the earth crust which make the ground vibrate and shake backward and forward. The shaking of earth crust proceeds in the form of waves from the centre of disturbance. Longitudinal waves, transverse waves and surface waves are the 3 types of waves. Earthquake may be caused by two types of forces.

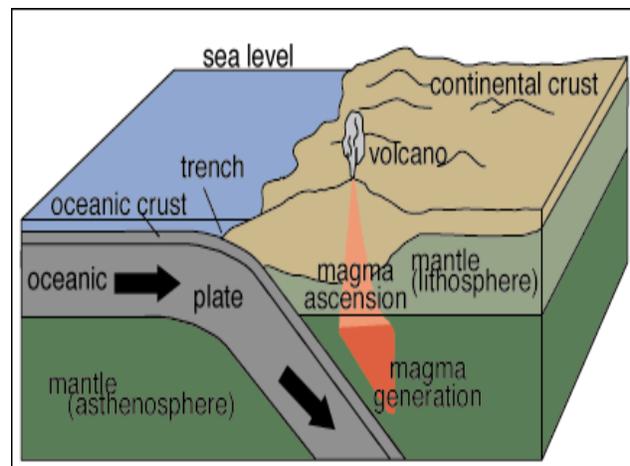
- 1) Tectonic occurrence: tectonic occurrence like faulting, breaking of rocks, raising or sinking of layers of the earth, folding of the strata or vapour seeking to escape from the earth.
- 2) volcanic activity: violent eruptions and intrusion of igneous magma from below the earth.

28.1 Types of earthquake:

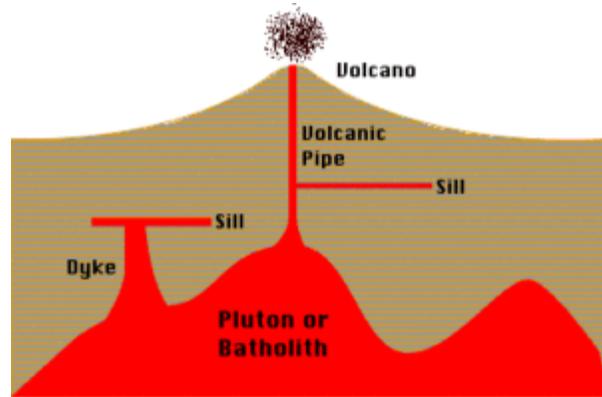
Volcanic earthquake: are associated with the flow of hot magma interrupting volcanoes. These happen to be localized and seldom cause any extensive damage.



Tectonic earthquake: are those which result from structural and adjustments inside the earth.



Plutonic earthquake: are those which have their origin at greater depths. They may also be generated in the same manner as the tectonic earthquake far below the surface of the earth.



28.1.2 Effects of earthquake:

- Collapse of manmade structure like building, bridges, towers etc.
- Roads get affected due to subsidence of the ground and enormous fissures appear on land.
- Extensive landslides in hilly regions and rocky debris come down to block the path of streams.
- When earthquake are accompanied by volcanic activity, the destruction is very enormous.

28.1.3 Mitigation measures:

- Damage to structure can be avoided by prohibiting restriction on such earthquake prone zones.
- Power lines and pipelines can be built with extra slack where they cross such earthquake prone zones.
- New buildings should be constructed with proper earthquake resistant measures. They require secure anchoring and tight bonding of foundations, frame, outer and inner walls, floors and roofs.
- Vulnerable older building located in high risk areas might be rebuilt to withstand anticipated earthquake.

28.1.4 Indian Scenario

It has been several years since the earthquakes struck Gujarat on January 26, 2001, rehabilitation has been done on a massive scale. Gujarat's experience has taught that building shelters with less vulnerability to earthquakes should also take into consideration of the specific needs of the victims instead of being a top-down approach. The role of NGO's in this is very important. Their strength lies in

their manpower, informality in operations and valuable human resources. Their ability to reach out to the community and sensitivity to local traditions is an asset in such situations.

The initiatives of the International Fund for Agricultural Development in supporting the self-employed Woman association (SEWA) and the Government's initiative in community-based livelihood security for earthquakes and drought victims have the potential to shape future disaster response and development projects in Gujarat, the Gujarat Woman's Economic Development Corporation (GWEDC) initiative in reviving woman's businesses after the calamity also provides many practical lessons in regenerating local economies and artisan markets.

The coordination between Government, local NGO's and local community initiatives, both for rescue as well as rehabilitation, needs to be strengthened as this can cause delays, overlaps and waste of relief material and efforts.

28.2 Land Slides and Mitigation Measures

In the recent years, intensive construction activity and the destabilizing forces of nature have aggravated the land Slide problem. Landslides refer to the downward sliding of huge quantities of land masses. Sliding occurs along steep slopes of hills of mountains. The rate of movement of such a mass is never constant. Landslides occur as a result of changes on a slope, sudden or gradual, either in its composition, structure, hydrology or vegetation. The changes can be due to geology, climate, weathering, changing land use and earthquakes.

The causes of landslides may be grouped into two types:

- Inherent or internal causes.
- Immediate causes.

28.2.1 Effect of landslides:

Landslides are not only destructive to the man but also to the structures. One of the most disastrous landslides occurred in Switzerland in 1806, when great masses of loose rock and soil suddenly slide down into the valley from the mountain side. It resulted in killing of 800 persons. Initially the Vajont Dam,

was the highest arch failed due to landslide on October 9, 1963, when a rock mass of about 600 million tons slide down into the lake.

- A significant reduction in hazards caused by landslides can be achieved by prevention of the exposure of population and facilitates by physically controlling the landslides.
- Development programs that involve modification of the topography, exploitation of natural resources and change in the balance load on the ground should not be permitted.
- Some critical measures that could be undertaken to prevent further landslides are drainage measures, erosion control measures such bamboo check-dams, terracing, jute and coir netting and rock control measures such as grass plantation, vegetated dry masonry walls, retaining walls and, most importantly, preventing deforestation and improving afforestation.
- Disasters cannot be totally prevented. However, early warning systems, careful planning and preparedness on part of the vulnerable community would help in minimizing the loss of life and property due to these disasters.
-

Lecture: 29

Social issues and the environment, unsustainable to sustainable development-

Sustainable Development

Human beings interact both with the social world and nature. Both, economic development and stable environment are required for the continual improvement of lifestyle and living standards. But until now, the development was human oriented and limited to rich nations. The development was achieved by damaging the environment and over exploitation of natural resources which were non renewable. That caused instability of environment and crossed the threshold limit of environmental damage.

Sustainable development can be defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” It is effective use of resources for economic development while preserving the environment and ecosystem so that not only the needs of presents are fulfilled



but also for the future generations. Sustainable development also interlinks the development and carrying capacity of environment and ecosystem.

29.1 Causes for Unsustainable Development.

- Some people argue that developing countries responsible for the degradation. Others hold Developing Countries are responsible for them.
- The important issues is not rate of increase of National Pollution, it is the rate of increase of Total Pollution. In this regard developed countries contribute much more than developing countries.
- Some people argue that raising population in the third world countries to be the crucial pollutant and it is essential to control it by all means.
- People should look at environment as not only reserve of man but of all living organism. So development has to sustain not only for man but also for all living organisms.

29.1.1 True sustainable development

It aims at optimum use of natural resources with high degree of sustainability, minimum wastage, least generation of toxic by products and maximum productivity.

i. Inter generational equity

We should minimize any adverse impacts on resources and environment for future generation.

ii. Intra generational equity

Technological development of rich countries should support economic growth of poor countries and lead to sustainability.

- Place more emphasis on pollution prevention and waste reduction.
- Recycle and reuse as many of our waste products and resources possible.
- Make more goods that last longer and easy to use, recycle and repair.
- Depend on renewable source of energy, sun wind, biomass, flowing water, geo thermal and tidal.
- Sustain Earths Biodiversity with emphasis on protecting vital habitats of the wild species.
- Use potentially renewable resources such as wastes soil, plants, animals no faster than they are renewed.
- Increase the usage of non renewable resources to minimize the resource depletion at a faster rate.
- Earth Degrading activities should be discouraged
- Reduce poverty and rate of population growth

29.1.2 Measures for sustainable Development:

a) Using appropriate technology

It is one which is locally adaptable, ecofriendly efficient and culturally suitable. It involves local labours, less resources and produces minimum waste. the Concept is ‘**Design with Nature**’.

b) 3-R Approach

Reduce, Reuse and Recycle approach.

Reduce the usage and also reduce the wastage of resource by making things that last longer and are easier to recycle, reuse and repair.

c) Promoting environmental education awareness

Environmental education will help in changing the thinking and attitude of people towards environment.

d) Population stabilization

We can achieve sustainable development by controlling population.

e) Conservation of nonrenewable resources

It should be conserved by recycling and reusing.

f) Usage of renewable resources

29.2 Social issues and Environment.

- Urban problems related to energy

- Water conservation-

- Rain water harvesting and water shed management,
- Recycling of industrial wastes,
- Construction of Storage reservoirs
- Better Agricultural Practices.

29.2.1 Rain water harvesting

The activity of collecting rain water directly recharging it into the ground to improve the ground water storage in the aquifer is called Rain Water harvesting. This may increase the level of ground water, reduce the ground water table depletion and arrest the sea water intrusion

Traditional methods - Temple tanks of India, Ponds

Modern methods- Absorption pit method, Absorption well method, Well cum Bore method, Group Houses – Terrace water saving method

Water shed management

Principles factors influencing watershed operations

- a. Physiography,
- b. Soil and Geology,
- c. Land Use,
- d. Climatological and meteorological information,
- e. Design peak runoff rate,
- f. Socio-economic factors.

Restoration and rehabilitation Techniques

The survival of human has now become an important issue to be concentrated, as human faces many threats for his survival too. He is disturbed to a maximum and at times, he needs resettlement too. Based on the causes, resettlement activities can be broadly grouped into 2 categories.

1. *Voluntary Rehabilitation*: Due to natural calamities such as Political, racial, religious disturbance, floods, cyclones, famines, earthquakes etc.,
2. *Involuntary Rehabilitation*: Due to construction of various types of developmental projects.

Environmental ethics

'If there is to be a war, let it be against environmental contamination, nuclear contamination, chemical contamination of soil and water systems'. The four basic tenets of biocentrism are:

- Humans are members of Earth's living community in the same way and on the same terms as all other living things,
- Humans and other species are inter-dependent,
- Each organism is a unique individual pursuing its own way, and
- Humans beings are not inherently superior to other living things.

Three principles of ethical conduct are:

- We should not harm any natural entity that has an intrinsic worth.
- We should not try to manipulate, control, modify, manage or interfere with the normal functioning of natural ecosystems, biotic communities or individual

- wild organisms, and
- We should not try to deceive or mislead any animal capable of being deceived or misled.

29.3 How to achieve sustainable development?

The following four rules can be defined as the key mantras of sustainability. These four rules are

- Reduce our dependency on heavy metals and fossil fuels such as coal, oil and natural gas.
- Reduce our dependency on synthetic chemicals.
- Reduce our destruction of nature which includes clearing of forest and natural habitats for human needs.
- The fourth principal is to ensure that we don't stop people from meeting their needs in order to achieve environmental sustainability. We must maintain a balance between environmental and economic sustainability.

Lecture: 30

The Environment Protection Act, The Air Act, The water Act, The Wildlife Protection Act and Forest Conservation Act

30. The Environment Protection Act, 1986

The Environment Protection Act, 1986 was constituted on 19 Nov, 1986, to provide protection and improvement of environment and for matters connected with environment. The spirit of the proclamation adopted by the United Nations Conference on Human Environment, held in Stockholm in June 1972, was implemented by the Government of India by creating this act.

There are four main chapters and different clauses under various chapters which lay down the standards, policies and act of environmental degradations and policies for improvement of environment and prevention of human beings from environmental hazards.

Chapter I - describes the definitions of various entities that are related to environment.

Chapter II - describes the role of central government to take measures for environment protection and its improvement along with the economic development. It includes the

appointment of officers, power to give directions, rules to regulate environmental pollution, laying down procedures and standards for industrial waste, emissions, hazardous waste etc.

Chapter III - Deals with the prevention, control and abatement of environmental pollution. As per the guidelines, a person running an industry or operation cannot emit or discharge environmental pollutants in excess of the permissible limit. Central government or its officers may take samples of air, water, soil or other substance from any factory for the purpose of analysis and upon failure to satisfy the norms, shall liable to be proceeded against and punished accordingly. Penalty- Imprisonment of five years with a fine upto one lakh rupees or it extend to Rs 5000 everyday.

Chapter IV - lists miscellaneous clauses which are not pertaining to environment but are guidelines for functioning and conduct of officers and government representatives and these guidelines must be laid before parliament for its validity.

30.2 The Air (Prevention And Control of pollution) Act,1981

As a control of the UN conference on Human environment held on June 1972, steps were taken to prevent all natural amenities and with this in view, this act has been enacted in 1981. It consists of 7 chapters and 54sections.

Chapter-I :This chapter defines the following terms such as air pollutant, air pollution, approved fuel ,automobile, chimney emission, control equipment etc.,

Chapter-II :It deals with the information regarding CPCB and SPCB, their constitutions, terms and conditions of service of members, delegation of powers to various officials.

Chapter-III :This chapter emphasizes the function of central board and state board such as to collect , compile and publish the data regarding air pollution and to guide the concerned industry for the effective prevention and control of air pollution.

Chapter-IV :This deals with prevention and control of air pollution. The boards are authorized to declare the air pollution control areas, instruct regarding the emission standards from automobiles and restrict the activities of certain industries. According to this chapter the industrial people are not permitted to allow excess pollutants with respect to standards and in such cases the board has the power to enter, inspect and collect sample, find out the reports in the state laboratories. On the basis of the report appeal can be made and the persons may bepunished.

Chapter-V :This chapter deals with the fund, accounts and auditing of the central and state boards.

Chapter-VI :If the industry or person fails to follow the standards, they will be punished.

Punishment:

Imprisonment for not less than one year and 6 months, it may extend to 6 years and with fine.

Chapter-VII :It deals with the power to amend the schedules, the necessity of state board to maintain a register containing relevant particulars and about the power of central and state government to make rules regarding the air pollution control.

30.3 The Water (Prevention and Control of Pollution) Act, 1974

The Water Act was enacted by Parliament Act, 1974 purpose to provide for the prevention of control of water pollution and the maintaining or restoring of wholesomeness of water. As on day, it is applicable in all the states of India. This act consists of 8 chapters and 64 sections

Chapter-I :This chapter explains the terms such as board, central ,stateboard, member, outlet sewer sewage effluent, trade effluent, stream and pollution.

Chapter-II :It elaborates about the constitution of central board , state board, committees, terms and conditions of service of members, meeting of the board. It also explains about delegation of powers to chairman, member secretary, officers and other employees of the board.

Chapter-III :It deals with the constitution, composition and the special provision of joint board. For eg. A Joint board for the river Cauvery includes officials from Karnataka, Tamilnadu and Pondicherry along with the Central boardofficials.

Chapter-IV :This chapter deals with the functions of central board, state board and their powers to give directions to concerned authorities.

Chapter-V :It explains the power of state government to collect samples of effluent, analyze in government laboratory and publish the results. On the basis of the result they may restrict the outlets and discharges into stream or well.

Chapter-VI :It deals with the maintenance of funds of central and state board, budgets, annual report submission, account and auditing.

Chapter-VII :This elaborates about the penalty in case of offences committed by companies.

Punishment: Imprisonment for not less than one year and six months but which may extend to 6 years with fine. Incase of failure, an additional fine of Rs.5000/ will be imposed for every day. In such case the names of the offenders may be even published.

Chapter-VIII :It explains about the central and state water laboratories, analysts, reports of the analysts, protection, action in good faith and about the power of central and state government to formulate the rules. Important sections under this act are

Under Section 19 :The entire National Capital Territory of Delhi has been declared as water pollution prevention control area.

Under Section 21 :Officials of DPCC can take samples of the water effluent from any industry stream or well or sewage sample for the purpose of analysis.

Under Section 23 : Officials of the state boards can enter any premises for the purpose of examining any plant, record, register etc. or any of the functions of the Board entrusted to him.

Under Section 24 :No person shall discharge any poisonous, noxious or any polluting matter into any stream, or well or sewer or on land.

30.4 The Wildlife (protection) Act, 1972

This act is framed for the protection of wild animals, birds and plants. This act comprises 7 chapters and 66 sections. This act extends whole of India except Jammu and Kashmir.

Chapter-I: It deals with the definitions of terms such as habitat, hunting, national park, reserved forest, sanctuary etc.

Chapter-II :It clearly explains the authorities to be appointed, formation of wildlife advisory board and its duties.

Chapter-III :It emphasizes the maintenance of record of wild animals killed or captured. Details regarding hunting of wild animals and regarding the license holder are elaborated.

Chapter-IV :It gives a notes on sanctuaries, national parks, game reserves ,permission to enter a sanctuary , prohibited areas, district collector's power in maintaining these areas and also includes the power of central government to declare such areas as national parks and sanctuaries.

Chapter-V : It tells about the trade of wild animals, animal products etc., This chapter clearly explains that any animal killed , captured or trapped is a government property and also elaborates regarding the regulation of transfer of animal.

Chapter-VI :This chapter explains about the penalties when found guilty under this act, 2 years imprisonment, Rs.2000/- fine ,either or both. And in a sanctuary or animal park, when an offence is committed, imprisonment for maximum 6 years, minimum 6 months and fine not less than Rs.500/- will be levied.

Chapter-VII :It deals with protection given to officers for action taken in good faith and explains the power provided to central and state government make to rules regarding the protection of wild life.

30.5 The Wildlife Protection Act , 1972

The Wildlife Protection Act of 1972 refers to a sweeping package of legislation enacted in 1972 by the Government of India. Before 1972, India only had five designated national parks. Among other reforms, the Act established schedules of protected plant and animal species; hunting or harvesting these species was largely outlawed.

The Act provides for the protection of wild animals, birds and plants; and for matters connected therewith or ancillary or incidental thereto. It extends to the whole of India, except the State of Jammu and Kashmir which has its own wildlife act. It has six schedules which give varying degrees of protection. Schedule I and part II of Schedule II provide absolute protection - offences under these are prescribed the highest penalties. Species listed in Schedule III and Schedule IV are also protected, but the penalties are much lower. Schedule V includes the animals which may be hunted. The plants in Schedule VI are prohibited from cultivation and planting. The hunting to the Enforcement authorities have the power to compound offences under this Schedule (i.e. they impose fines on the offenders). Up to April 2010 there have been 16 convictions under this act relating to the death of tigers.

Government of India enacted a comprehensive legislation Wildlife Protection Act of 1972 with the objective of effectively controlling poaching and illegal trade in wildlife and its derivatives. This has been amended (and signed) in January, 2003 and punishment and penalty for offences under the Act have been made more stringent.

Forest (Conservation) Act,1980

Earlier the Indian Forest Act, 1927 was adopted to include reserved forests, village forests, protected forests and non-Govt. forests. This act regulated the duty levied on timber and other forest producers. But this act does not in to consideration about conservation protection of forests. In addition this act does not consider or include the tribal who were the most conservators and protectors of forest. Hence the forests (conservation) Act, 1980 was adopted. This act has different sections to deal with various concepts related to conservation of forests.

1. This Act has the main aim to protect all types offorests.
2. Thus indirectly help to maintain the ecosystem and biologicaldiversity.
1. This Act, stresses that the state government would be empowered to declare a reserve forests as unreserved and any forest land cannot be used for non-forest purpose i.e., any purpose other thanafforestation.
2. This act further checks the operations that must be carried out in forests such as mining which will cause ecological imbalance leading to environmentaldeterioration.
3. According to this act the central government has the authority to maintain an ecological balance in the forest extending from the tropical to temperateregions.

4. This act was enacted and strictly followed on the basis of the fact that forest is a valuable treasure. Forest is defined as an ecosystem in which trees are dominant form of vegetation, the plants, animals and the soil play an important role.
5. This act comprises of five important sections
 - The first section deals with the usage of the forestland for non-forest purpose as described earlier.
 - The next section explains the constitution of forest advisory committee.
 - The next section explains the penalties when the act is violated. It includes simple imprisonment up to a period of 15 days. In such case the authority responsible for that area will also be punished.
 - The next section explains the power of central government to make rules regarding the forest conservation.

30.6 Department of Environment, Forests and Wildlife of India

Department of Environment was set up in 1980 to serve as the local point in the administrative structure of the Government for planning, promotion and coordination of environmental programmes.

The present integrated Department of Environment, Forests and Wildlife in the Ministry of Environment and Forests was created in September 1985. The Ministry serves as the local point in the administrative structure of the Central Government of the planning, promotion and coordination of environmental and forestry programmes. The Ministry's main activities are, the survey and conservation of flora, forests and wildlife, prevention and control of pollution, afforestation and regeneration of the degraded areas of the environment.

30.7 Environmental Impact Assessment

Environmental impact assessment is a written analysis or process that describes and details the probable and possible effects of planned industrial or civil project activities on the ecosystem, resources, and environment. The National Environmental Policy Act (NEPA) first promulgated guidelines for environmental impact assessments with the intention that the environment receives proper emphasis among social, economic, and political priorities in governmental decision-making. This act explains the importance of environmental impact assessments for major federal actions affecting the environment. Many states now have similar requirements for state and private activities. Such written assessments are called Environmental Impact Statements or EISs.

30.8 Environmental laws

Major legislations directly dealing with the protection of environment in India are

1. The wild life protection Act,1972.
2. The forest conservation Act,1980.
3. The water (Prevention and control of pollution) Act,1974.
4. The air (Prevention and control of pollution) Act,1981.
5. The Environment (Protection) Act,1986.
6. The Public Liability Insurance Act, 1991.
7. The National Environment Tribunal Act,1995.

Lecture: 32

Woman and child welfare, HIV/AIDS and Role of information technology on environment and human health.

Women are part and parcel of environment. Women have direct relationship with their immediate environment. Regularly they collect water, fuel wood, foods like nuts, fruits, leaves, roots etc. So women have closer vicinity with the flora and fauna of that region by living with them. Women as a social category, perform multiple role. Certain roles have been recognized universally. The physical differentiation between men and women necessitates certain social arrangements for procreation and rearing of children. Man created practices and customs which tied woman to motherhood in a familial social responsibility. A set of norms were created to curb her freedom, creative potential and suppress her in society.

Women experienced depending syndrome particularly dependency on father during childhood, dependency on the husband in adulthood and dependency on the son in old age. This made her position subordinate to man and easy exploitation women bear and rear children but no proper care for her role of motherhood. Neglect of mother and motherhood lead to maternity deaths, in human custom of female in infanticide etc. Because of poor stimulation of living and economic backwardness, women suffer from nutritional deficiency, during pregnancy and lactation. So it is necessary that there women should be educated to bring them out and should be provided with proper training to create suitable awareness and insight into the new demands in the physical and social environment.

32.1 Woman welfare and development

Even through, the first five ‘‘ Five year plans’’ were focusing on women’s welfare,

only from the sixth 'Five year plan' (1980-1985) onwards, women were recognized as separate target group involving developmental planning activities. The 1991 census revealed that women constitute 48.1 percent of the country's population. Hence it is understood that for the development of the nation backwardness of women has to be taken care.

32.2 Women rights and privileges

The constitution of India not only guarantees equality for women, but also empowers state to adopt measures of positive discrimination in favours of women in order to overcome their disadvantages in socio economic, educational and political fields. There are many articles in the constitution specifically encourages the development of woman in the society.

- **Article 14** - States that equal rights and opportunities for men and women in the political, economic and social spheres.
- **Article 15** - Prohibits discrimination against any citizen on the grounds of religion, caste and sex.
- **Article 15(3)** - Makes a special provision enabling the state to make positive discrimination in favour of women.
- **Article 15(A) (e)** - Condemn the practices derogatory to the dignity of women.
- **Article 16** - Provides for equal opportunities in matter of public appointments.
- **Article 39(a)** - States that state shall direct its policy towards securing all citizens, men and women equally the right to means of livelihood.
- **Article 39(c)** - Confirms that equal pay for equal work.
- **Article 42** - Directs the state to provide the citizens the just and human conditions at work and maternity relief.

32.2.1 Policies concerning women's development

Various policies advocating women's welfare and development have been evolved by the government. Some of them are given below.

- a) The national plan of action for women (NPA) 1976.
- b) The national perspective plan for women (NPP) 1988-2000.
- c) Shramshakti 1988.
- d) The national nutritional policy (NNP) 1993.
- e) The national plan and action for the girl child (NPA) 1991-2000.
- f) National commission for women's act (new) 1990.

32.3 Child welfare and development

The future of a nation depends on the way in which the children are growing nutritionally, educationally and socially. Many children suffer from malnutrition and die for want of immunization. The national policy for children was formulated in the year 1974.

- Children are 'a supremely important asset' of the nation.

- It is duty of the state “ to provide adequate services to the children both before and after birth and through the period of growth”.

Provision of early childhood services especially to the weaker and more vulnerable section of the community could help , prevent or minimize infant mortality, morbidity, malnutrition and stagnation inschools.

India has the world’s largest integrated child development services (ICDS) program started in the year 1975, which involves supplementary nutrition, immunization, health care, growth monitoring, pre-school education and health and education. ICDS provides health checkup service like antenatal care for pregnant women, post-natal care for nursing mothers and healthcare for children less then 6 years of age. Children less than 6 years in the village are periodically examined, weighed, immunized at prescribed times and treated for ailments. Provision for nutrition and health education has been made for women 40-45 years of age with priority given to pregnant and lactation mothers. ICDS provide the facilitieslike

- Foundation forpersonality.
- Reduction ofdeprivation.
- Effective Co ordination for policyimplementation.

Maternity and motherhood care through education and healthcareAccording to the Indian constitution that free and compulsory education for all children would be provided until they complete the age of fourteen years. There has been special emphasis in monitoring the drop outs in primaryeducation.

National policy for children

The children population of India is nearly 300 million and the majority of the children live under socially and economically under privileged conditions that can lead to deterioration of the child’s physical and mental development. The national policy for children (NPC) 1974 was founded on the conviction that child development programmes can ensure equality of opportunity to the poor children.

Various organizations towards child welfare

i) UN conventions on rights of child or internationallaw

It formulated a set of international standard and measures to promote and protect the well being of children in our society.

Rights of the child

The international law defines right of the child to survival, participation, development and protection.

- The right to survival:** It emphasis on good standards of living, good nutrition andhealth.
- The right to participation:** It means freedom of thought and appropriate information to child.
- The right to development:** It ensures access to education, child hood care and support, social security andrecreation.
- The right to protection:** It means freedom from exploitation in human treatment

and neglect.

ii) **World summit on child:** It had focused agenda for the well being of the children targeted to be achieved in the beginning of the new millennium.

iii) **Ministry of Human Resource Development(MHRD):** It concentrates on child's health, education, nutrition, clean and safe drinking water, sanitation and environment.

32.4 Acquired Immune Deficiency Syndrome(AIDS)

AIDS is caused by virus called HIV (Human Immune deficiency Virus). HIV breaks down the body's immune system leaving the patient to a number of life threatening infections. The AIDS patient will be getting different kinds of severe infections including cancer, neurological disorders, skin diseases finally leading to death. As HIV infected person receives a diagnosis of AIDS after developing one of the AIDS indicator illnesses. A positive HIV test result does not mean that a person has AIDS. A diagnosis of AIDS is made by a physician using certain clinical criteria, AIDS illness indicator.

AIDS was discovered in 1983, though sufficient knowledge has been gained about the disease, yet a definite source of this virus could not be identified, but some of the sources are

1) Through African monkey

Most of the evidences have suggested that the AIDS has spread from Africa. It has been believed that the HIV has transferred to humans from African monkey or chimpanzees.

2) Through Vaccine programmes

- HIV has spread in Africa through HIV contaminated polio vaccine prepared from monkey's kidney
- It had spread through Hepatitis – B viral vaccine in Los Angeles and New York.
- It had also spread through small pox vaccine programme of Africa

World Scenario

HIV/AIDS is the fourth leading cause of death in the world. Globally the AIDS epidemic has crossed over 20 million deaths and orphaned more than 14 million children. Nearly 90 % of the people who are infected with AIDS live in developing countries. 13 % of world's population lives in Africa, almost all states of African countries were affected by HIV. About 3 million people so far died due to HIV/AIDS in 2003. AIDS is rapidly spreading in Eastern Europe and Asia. India ranks second in the world with 5.1 million HIV/AIDS affected people. The percentage is lower than Thailand, Myanmar and South Africa.

Scenario in India

The largest numbers of infected cases have been found in Maharashtra and Tamil Nadu, followed by Delhi, UP, Karnataka and Goa. In Tamil Nadu alone, till September 2008 a total of 24,667 cases of AIDS have been found out. The first HIV +ve case was identified in Chennai in 1986.

Mode of transmission of AIDS

Some of the key factors responsible for the spread of the deadly disease AIDS are

- Prostitution
- Homosexualactivity
- Use of contaminated syringe or needle in bloodtransfusion.
- Maternal-fetal transmission i.e. a mother infected with AIDS can give birth to baby withAIDS.
- Other factors such as saliva, breast milk etc are also the mediums of transmittance of this disease. These body fluids have been proven to spreadHIV

Blood

Semen

Vaginal
fluid

Breast milk

Other body fluids containing blood.

- These are additional body fluids that may transmit the virus that healthcare workers may come into contactwith
 - Fluid surrounding the brain and spinalcord.
 - Fluid surrounding the bonejoints.Fluid surrounding an unbornbaby

HIV tests

The most commonly used test is ELISA. Most of the hospitals are insisting of HIV test nowadays. If the sample shows positive results even after duplication, the results are confirmed using a second test called” Western blot”.In addition the following other test also usednowadays.

- Radioimmunoprecipitation assay (RIPA).
- Dot Blot Immunobinding Assay.
- Immunoflourescence assay.
- Nucleic acidtesting.
- Polymerase ChainReaction.

Functions of HIV in human body

AIDS itself does not kill humans. The death occurs due to the attack by diseases because of the weakening of immune system, white blood cell (WBC) responsible in the formation of antibodies are called T-helper cells. T-helper cells are the key infection fighters in the immune system. The HIV enter into the human body and destroys the T-cells, as a result of which various

types of infection disease occur. Even cancer can easily develop in the HIV infected persons.

Various stages of HIV infection

The HIV infection stages can be divided into four stages clinically.

- 1) The first stage is the initial infection in the blood the destruction of T-4 cells or lymphocytes or white blood corpuscles.
- 2) The second stage is the symptomatic carrier stage.
- 3) The third stage is the AIDS Related complex (ARC).
- 4) The final stage is the fully infected AIDS patient receiving different kinds of infections.

Symptoms for

HIV/AIDS Minor

symptoms

- Persistent cough for more than one month
- General skin disease
- Viral infection
- Fungus infection in mouth and throat
- Frequent fever, head ache, fatigue

Major symptoms

- fever for more than one month
- diarrhea for more than one month
- cough and TB for more than 6 months
- fall of hair from the head
- 10% of body weight get reduced within a short period

Screening test

The antibodies to HIV virus can be easily detected through blood tests. Hence the presence of HIV antibodies in the blood sample can confirm the HIV infection of HIV positive. One of the HIV test "ELISA, western blot" is a highly reliable test for HIV. HIV can be isolated from cultured lymphocytes, but it is an expensive and time consuming test.

Control of AIDS

1) Safe sexual activity and sex

Since AIDS is a sexually transmitted disease due to mainly prostitution and homosexual activity. Proper moral education as well as sex education using good condoms etc., should be given to the illiterate as well as the public at large.

2) AIDS education and educating the AIDS patients

The Public should be educated regarding the severity of the disease. For AIDS there is no vaccine or no remedial medicines have been so far successfully discovered. The AIDS patients have to undergo a gradual deterioration process to death. Since the HIV affects the immune system by destroying the lymphocytes (White Blood Corpuscles) count, the AIDS patient is highly vulnerable to any kind of infection from cough, cold etc., to cancer, typhoid etc, and cannot be treated through any kind of antibiotics or any other kind of drugs due to his shattered immunity system. Finally the AIDS patient will become a prey to any one of the severe kind of infections.

The public should also be educated to treat AIDS patients with sympathy and concern. Since AIDS patients with sympathy and contact, people should be educated not to isolate them. Clinical and social workers should be specially trained for the welfare activities of AIDS patients. In the high school level itself, proper education regarding the prevention of AIDS and the clinical and social aspects of AIDS should be taught in the class rooms.

3) Educating illiterates as well as the educated public about AIDS prevention measures using different medias

Various Medias such as radio, television, wall posters, pamphlets, booklets, etc should be efficiently made use for educating the public to be cautious about AIDS. The public should be educated regarding the various ways of transmission of the disease.

Role of Information Technology In Environment and Human Health

Today is an information age and tremendous flow of information is emerging in all fields throughout the world. Information in this competitive era is more precious than life and without information one cannot live at all. India is endowed with rich natural resources while facing the problems of poverty, illiteracy, population growth , environmental degradation etc. It is creating new possibilities to tackle these problems.

