ENVIRONMENTAL STUDIES

UNIT -1 : MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

'**Environment**' is derived from the French word Environner which means to Encircle or surround. All the biological and non-biological things surrounding an organism are thus included in Environment. Thus Environment is sum total of water, air and land, inter-relationships amongthemselvesandalsowiththehuman- beings,other living organisms and property. The abovedefinitiongiven in Environment (Protection) Act, l986 clearly indicates that Environment includes all the physical and biological surroundings and their interactions. Thus, in order to study Environment one needs knowledge inputs from various disciplines. Life Sciences including Botany, Zoology, Microbiology, Genetics, Biochemistry and Biotechnology help in understanding the biotic component and their interactions. The physical and chemical structureof the abiotic componentsand Energytransferandflowareunder- stood with the help of basic concepts of Physics, Chemistry, Geology, Atmospheric Science, Oceanographyand Geography. Mathematics, Statistics and Computer Science serve as effective tools in Environmental modeling and management. Subjects like Education, Economics, Sociology and Mass communication provide the inputs for dealing with the socio-economic aspects associated with various developmental activities. A synthesis with Environmental Engineering, Civil Engineering, Hydraulics and Chemical Engineering form the basis for various technologies dealing with the control of Environmental pollution, waste treatment and development of cleaner technologies that are important for protection of the Environment. Environmental laws provide the tools for effective management and protection of the Environment. environmental Studies, therefore, is a multi-disciplinary subject where differentaspectsaredealtwithaholisticapproach.

Scope

Scopeof Environmentalstudies is broad based and it Encompassesa largenumberofareasandaspects,broadlylistedbelow:

- Natural Resources—their conservation and management
- Ecology and biodiversity
- Environmental pollution and control
- Socialissuesinrelation to developmentand Environment
- Human population and Environment

These are the basic aspects of Environmental Studies which have a direct relevance to every section of the society. Environmental studies can be highly specialized also which may concentrate on more technical aspects like Environmental Science, Environmental Engineering, Environmental Management, Environmental Biotechnologyetc. Environment belongs to alland is thus important for all. Whatever be the occupation or age of a person, he or she will be affected by Environment and will also affect the Environment by his or her deeds. Thus, Environment is one subject that is actually global in nature. For example, atmosphere has no boundaries and the pollutants produced at one place can be dispersed and transported to another place. The river water polluted by industrial or municipal discharge at one point would seriously affect the downstream aquatic life. Damage to the forests in a hilly region will have far reaching effect not only on the hills but also on the plains. This is because Environment is a closely and intricately woven network of components and functions. There are some Environmental problems which may be of localized importance but there are some major issues like global warming, depletion of ozone layer, dwindling forests and Energy resources, loss of global biodiversity etc. that are going to affect the mankind as a whole and for that we have to think globally. For dealing with local Environmental issues, e.g. the impacts of mining or hydro-electric projects, solid waste management etc. we haveto think and act locally. Inorder to makethepeopleawareaboutthose aspects of Environment with which they are so intimately associated, it is very important to make every one Environmentally educated.

Importance

Environmental studies is very important since it deals with the most mundane issues like safe and clean drinking water, hygienic living conditions, clean and fresh air, fertile land, healthy food and development that is sustainable. There is a need for trained manpower at every level to deal with Environmental issues. Environmental law, business administration and Environmental Engineering are emerging as new career opportunities for Environmental protection and management. With the pollution control laws becoming more stringent, industries are finding it difficult to dispose off the produced wastes. In order to avoid explosive litigation, various companies are now trying to adopt green technologies, which would reduce pollution. Investing in pollution control technologies will reduce pollution as well as cut on costs for effluent treatment. Market for pollutioncontroltechnology is huge the world over. Cleaning up of the wastes produced is another potential market. It is estimated to be more than $ l00 billion per year for all American business. Germany and Japan having more stringent laws for many years have gained more experience in reducing effluents. Still there is a $ 200 billion market for cleaning up the former east Germany alone. In India also the Pollution Control Boards are seriously implementing pollution control laws and insisting on up gradation of

effluents to meettheprescribed standardsbeforetheyaredischarged on land or into a water body. Many companies not complying with the orders have been closed or ordered to shift. This is in fact essential if we want to live in a clean, healthy, aesthetically beautiful, safe and secure Environment for a long time and wish to hand over a clean and safe earth to our children, grand-children and great grand children.

Need for Public Awareness

The United Nations Conference on Environment and Development held in Rio de Janeiro in l992 and popularly known as 'Earth Summit' followed by the World Summit on Sustainable Development at Johannesburg in 2002, just l0 years after the first summit, have high- lighted the key issues of global Environmental concern and have attracted the attention of the general public towards the deteriorating Environment. Any government at its own level cannot achieve the goals of sustainable development until the public has a participatory role in it. Public participation is possible only when the public is aware about the ecological and Environmental issues. A drive by the government to ban the littering of polythene cannot be successful until the public understandsthe Environmentalimplicationsof thesame. Thepublichas to beeducatedaboutthefactthatif weare degrading our Environment weareactuallyharmingourown selves. Thisisbecause weareapartof thecomplexnetworkof Environmentwhere every component is linked to another. At is all the more important to educate the people that some- times the adverse impact of Environment are not experienced or noticed until a threshold is crossed. So we may be caught unawares by a disaster. There is a Chinese proverb "It you plan for one year, plant rice, if you plan for l0 years, plant trees and if you plan for l00 years, educate people." If we want to manage our planet earth, we have to make all the persons environmentally educated. In l99l, the Supreme Court of our country issued directive to make all curricula Environment-oriented. This directive was, in fact, in response to a Public Interest Litigation (PEL) filed by M.C. Mehta vs. Union of India (l988) that prompted the apex court to give a mandate for creatingEnvironmental awareness among all citizens ofIndia.

Today everybody talks of Environment, but only a few have clear ideas about what needs to be done and still fewer have the actual experience or expertise in the field. Unfortunately, Environmental awareness campaigns have very often been exploited for political propaganda rather than being an integral part of our educational programmers' in theory and practice. "Environment" is very wrongly taken as a "fashion" by all walks of life, hardly realizing that it is our "real-life-situation" and our sustenance and security are at stake. Henry D. Thoreau rightly says "What³s the use of a beautiful house if you don³t have a decent planet to put it on?" Even if we begin today, the restorationisexpectedinthenext40-70years.

Population Growth And Their Effects On Environment:

Our global human population, 6 billion at present, will cross the 7 billion mark by 20l5. The needs of this huge number of human beings cannot be supported by the Earth's natural resources, without degrading the quality of human life.

In the near future, fossil fuel from oil fields will run dry. It will be impossible to meet the demands for food from existing agro systems. Pastures will be overgrazed by domestic animals and industrial growth will create ever-greater problems due to pollution of soil, water and air. Seas will not have Enough fish. Larger ozone holes will develop due to the discharge of industrial chemicals into the atmosphere, which will affect human health. Global warming due to industrial gases will lead to a rise in sea levels and flood all low-lying areas, submerging coastal agriculture as well as towns and cities. Water 'famines' due to the depletion of fresh water, will create unrest and Eventually make countries go to war. The control over regional biological diversity, which is vital for producing new medicinal and industrial products, will lead to grave economic conflicts between biotechnologically advanced nations and the biorich countries. Degradation of ecosystems will lead to extinction of thousands of species, destabilizing natural ecosystems of great value. These are only some of the Environmental problems related to an increasing human population and more intensive use of resources that we are likely to face in future. These effects can be averted by creating a mass Environmental awareness movement that will bring about a change in people's way oflife.

Increase in production per capita of agricultural produce at a global level ceased during the l980's. In some countries, food shortage has become a permanent feature. Two of every three children in South Africa are underweight.

In other regions famines due to drought have become more frequent. Present development strategies have not been able to successfully address these problems related to hunger and malnutrition. On the other hand, only l5% of the world's population in the developed world is earning 79% of income! Thus the disparity in the extent of per capita resources that are used by

people who live in a ‘developed’ country as against those who live in a ‘developing’ country is extremely large. Similarly, the disparity between the rich and the poor in India is also growing.

The increasing pressures on resources place great demands on the in-built buffering action of nature that has a certain ability to maintain a balance in our Environment. However, current development strategies that essentially lead to short-term gains have led to a breakdown of our Earth’s ability to replenish the resources on which we depend.

Global population growth

The world population is growing by more than 90 million per year, of which 93% is in developing countries. This will essentially prevent their further economic ‘development’. In the past, population growth was a gradual phenomenon and the Earth’s ability to replenish resources was capable of adjusting to this increase. In the recent past, the escalation in growth of human numbers has become a major cause of our Environmental problems.

Present projections show that if our population growth is controlled, it will still grow to 7.27 billion by 20l5. However, if no action is taken it will become a staggering 7.92 billion.

Human population growth increased from: l to 2 billion, in l23 years. 2 to 3 billion, in 33 years. 3 to 4 billion, in l4 years. 4 to 5 billion, in l3 years. 5 to 6 billion, in ll years. It is not the census figures alone that need to be stressed, but an appreciation of the impact on natural resources of the rapid escalation in the rate of increase of human population in the recent past. The extent of this depletion is further increased by affluent societies that consume per capita more Energy and resources, that less fortunate people. This is of great relevance for developing a new ethic for a more equitable distribution of resources.

In the first half of the l900s human numbers were growing rapidly in most developing countries such as India and China. In some African countries the growth was also significant. In contrast, in the developed world population growth had slowed down. It was appreciated that the global growth rate was depleting the Earth’s resources and was a direct impediment to human development. Several Environmental ill-effects were linked with the increasing population of the developing world. Poverty alleviation programs failed, as whatever was done was never Enough as more and more people had to be supported on Earth’s limited resources. In rural areas population growth led to increased fragmentation of farm land and unemployment. In the urban sector it led to inadequate housing and an increasing level of air pollution from traffic, water pollution from sewage, and an inability to handle solid waste. By the l970s most countries in the developing world had realized that if they had to develop their economics and improve the lives of their citizens they would have to curtail population growth.

Though population growth shows a general global decline, there are variations in the rate of decline in different countries. By the l990s the growth rate was decreasing in most countries such as China and India. The decline in the 90s was greatest in India. However, fertility continues to remain high in sub Saharan African countries. There are cultural, economic, political and demographic reasons that explain the differences in the rate of population control in different countries. It also varies in different parts of certain countries and is linked with community and/ or religious thinking. Lack of Government initiatives for Family Welfare Program and a limited access to a full range of contraceptive measures are serious impediments to limiting population growth in several countries.

Population Explosion – Family Welfare Program

In response to our phenomenal population growth, India seriously took up an effective Family Planning Program which was renamed the Family Welfare Program. Slogans such as ‘ Hum do hamare do ’ indicated that each family should not have more than two children. It however has taken several decades to become effective. At the global level by the year 2000, 600 million, or 57% of women in the reproductive age group, were using some method of contraception. However the use of contraceptive measures is higher in developed countries –68%, and lower in developing countries - 55%. Female sterilization is the most popular method of contraception used in developing countries at present. This is followed by the use of oral contraceptive pills and, intrauterine devices for women, and the use of condoms for men. India and China have been using permanent sterilization more effectively than many other countries in the developing world. The best decision for the method used by a couple depends on a choice that they make for themselves. This must be based on good advice from doctors or trained social workers who can suggest the full range of methods available for them to choose from. Informing the public about the various contraceptive measures that are available is of primary importance. This must be done actively by Government Agencies such as Health and

Family Welfare, as well as Education and Extension workers. It is of great importance for policy makers and elected representatives of the people – Ministers, MPs, MLAs at Central and State levels – to understand the great and urgent need to support Family Welfare. The media must keep people informed about the need to limit family size and the ill effects of a growing population on the worlds resources.

The decision to limit family size depends on a couple's background and education. This is related to Government Policy, the effectiveness of Family Welfare Programs, the educational level, and information levels in mass communication. Free access to Family Welfare information provided through the Health Care System, is in some cases unfortunately counteracted by cultural attitudes. Frequently misinformation and inadequate information are reasons why a family does not go in for limiting its size.

The greatest challenge the world now faces is how to supply its exploding human population with the resources it needs. It is evident that without controlling human numbers, the Earth's resources will be rapidly exhausted. In addition economically advanced countries and rich people in poorer countries use up more resources than they need.

As population expands further, water shortages will become acute. Soil will become unproductive. Rivers, lakes and coastal waters will be increasingly polluted. Water related diseases already kill l2 million people every year in the developing world. By 2025, there will be 48 countries that are starved for water. Air will become increasingly polluted. Air pollution already kills 3 million people every year.

The first 'green revolution' in the '60s produced a large amount of food but has led to several Environmental problems. Now, a new green revolution is needed, to provide Enough food for our growing population, that will not damage land, kill rivers by building large dams, or spread at the cost of critically important forests, grasslands and wetlands.

The world's most populous regions are in coastal areas. These are critical ecosystems and are being rapidly destroyed. Global climate change is now a threat that can affect the very survival of high population density coastal communities. In the sea, fish populations are suffering from excessive fishing. Once considered an inexhaustible resource, over fishing has depleted stocks extremely rapidly. It will be impossible to support further growth in coastal populations on existing fish reserves.

Human populations will inevitably expand from farm lands into the remaining adjacent forests. Many such encroachments in India have been regularized over the last few decades. But forest loss has long-term negative effects on water and air quality and the loss of biodiversity is still not generally seen as a major deterrent to human well-being. The extinction of plant and animal species resulting from shrinking habitats threatIns to destroy the Earth's living web of life.

Energy use is growing, both due to an increasing population, and a more Energy hungry lifestyle that increasingly uses consumer goods that require large amounts of Energy for their production, packaging, and transport. Our growing population also adds to the Enormous amount of waste. With all these linkages between population growth and the Environment, Family Welfare Programs have become critical to human existence .

Planning for the future

How Governments and people from every community meet challenges such as limiting population size, protecting the natural Environment, change their consumer oriented attitudes, reduce habits that create excessive waste, elevates poverty and creates an effective balance between conservation and development will determine the worlds future.

The Urban Challenge

Population increases will continue in urban centers in the near future. The UN has shown that by 2025 there will be 2l "megacities" most of which will be situated in developing countries. Urban centers are already unable to provide adequate housing, services such as water and drainage systems, growing Energy needs, or better opportunities for income generation.

Methods of sterilization

India's Family Welfare Program has been fairly successful but much still needs to be achieved to stabilize our population.

The most effective measure is the one most suited to the couple once they have been offered all the various options that are available. The Family Welfare Program advocates a variety of measures to control population. Permanent methods or sterilization are done by a minor surgery. Tubectomy in females is done by tying the tubes that carry the ovum to the uterus. Male sterilization or vasectomy is done by tying the tubes that carry the sperm. Both are very simple procedures, done under local anesthesia, are painless and patients have no post operative problems. Vasectomy does not cause any loss in the male's sexual ability but only arrests the discharge of sperm.

There are several methods of temporary birth control. Condoms are used by males to prevent sperms from fertilizing the ovum during intercourse. Intrauterine devices (Copper Ts) are small objects which can be placed by a doctor in the uterus so that the ovum cannot be implanted, Even if fertilized. They do not disturb any functions in the woman's life or work. Oral contraceptive tablets (pills) and injectable drugs are available that prevent sperms from fertilizing the ovum.

There are also traditional but less reliable methods of contraception such as abstinence of the sexual act during the fertile period of the women's cycle and withdrawal during the sexual act.

Stockholm Conference- l972.

Stockholm Conference was held at Stockholm (Sweden) on June l6,l972. It was the first global Conference on Environment, Chaired by Maurice F.Strong, a Canadian Environmentalist an participated by l44 countries to discuss the Environmental issues. Smt. Indira Gandhi was the only visiting head of the state to participate in that U.N. Conference on human Environment. India fully supported the principles of the Conference and Mrs. Gandhi emphasized the need of removal of poverty and also stated it must be the integral part of the goal of an Environmental strategy for the world. They have adopted declarations on the Human Environment consisting of a preamble and 26 principles. By the preamble, the Conference proclaimed that the defense and improvement of the human Environment, both natural and man-made, had become an imperative for mankind to be pursued, together with the fundamental goals of peace and of worldwide economic and social development. The achievement of this goal was the responsibility of citizens, communities and institutions at every level. Although local and national governments would bear the greatest burden for large scale Environmental policy and action Within their jurisdictions, international cooperation was also needed, both to raise resources to support the developing countries in carrying out their responsibilities in this field, and to recognize that a growing class Environmental problems was regional or global in extent.

By the preamble, the Conference also, among other things, affirmed that in the developing countries most of the Environmental problems are caused by under development, whereas in the industrialized countries they were generally related to

industrialization and technological development. The Conference also declared that the natural growth of population continuously presented problems on the preservation of the Environment, and required the adoption of adequate policies and measures, wherever appropriate.

The Conference then laid down the following 26 principles.

l. Man had a fundamental right to freedom, equality and adequate conditions of life in an Environment of a quality that permitted a life of dignity and wellbeing, and he bore a solemn responsibility to protect and improve the Environment for present and future generations. In this respect, policies promoting or perpetuating apartheid, racial segregation, discrimination colonial and other forms of oppression and foreign domination stood condemned and had to be eliminated.

2. The natural resources of the earth, Including the air, water, land, flora and fauna and, especially, representative samples of natural ecosystems, were to be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate.

3. The capacity of the earth to produce vital Renewable resources was to be maintained and, wherever practicable, restored or improved.

4. Man had a special responsibility to safeguard and wisely manage the heritage of wildlife and its habitat, which were now gravely imperiled by a combination of adverse factors. Nature conservation, including wildlife, was therefore, to give importance in planning for economic development.

5. The non-Renewable resources of the earth were to be employed in such a way as to guard against the danger of their future exhaustion and to Insure that all mankind shared benefit from such employment.

6.The discharge of toxic substances or of other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the Environment to render them harmless, had to be halted in order to Insure that serious or irreversible damage was not inflicted upon ecosystems. The just struggle of the people of all countries against pollution should be supported

7. States were to take all possible steps to prevent pollution of the seas by substances that wets liable to create hazards to human health, to harm living sources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.

8. Economic and social development was essential for Insuring a favorable living and working Environment for man and for creating conditions on earth, which were necessary for the improvement of the quality of life.

9.Environmental deficiencies generated by the conditions of underdevelopment and natural disasters posed grave problems and could best be remedied by accelerated development through the transfer of substantial quantities of financial and technological assistance as a supplement to the domestic effort of the developing countries and such timely assistance as might be required.

l0. For the developing countries, stability of prices and adequate earnings for primary commodities and raw material were essential to Environmental management since economic factors as well as ecological processes had to be taken into account.

ll. The Environmental policies of all states should enhance and not adversely affect the present or future development potential of developing countries, nor should they hamper the attainment
of better living conditions for all and appropriate steps should be taken by states and international organizations with a view to reaching agreement on meeting the possible national and international economic consequences resulting from the application of Environmental measures.

l2. Resources should be made available to preserve and improve the Environment, taking into account the circumstances and particular requirements of developing countries and any costs which might emanate (spread out from the source) from their incorporating Environmental safeguards into their development planning and the need for making available to them, upon their request, additional international technical and financial assistance for this purpose.

l3. In order to achieve a more rational management of resources and thus to improve the Environment, states should adopt an integrated and coordinated approach to their development planning so as to Insure that development was compatible with the need to protect and improve the human Environment for the benefit of their population.

l4. Rational planning constituted an essential tool for reconciling any conflict between the needs of development and the need to protect and improve the Environment.

l5. Planning was to be applied to human settlements and urbanization with a view to avoid adverse effects on the Environment and obtaining maximum social, economic and Environmental benefits for all. In this respect, projects, which were designed for colonialist and racist domination, had to be abandoned.

l6. Demographic policies, which were without prejudice to basic human rights and which were deemed appropriate for Governments concerned, should be applied in those regions where the rate of population concentrations was likely to have adverse effects on the Environment of development or where low population density might prevent improvement of the human Environment and impede development.

l7. Appropriate national institutions were to be entrusted with the task of planning, managing or controlling the Environmental resources of states with the view to enhancing Environmental quality.

l8. Science and technology, as part of their contribution to economic and social development, were to be applied to the identifications, avoidance and control of Environmental risks and the solution of Environmental problems and for the common good of the mankind.

l9. Education in Environmental matters, for the younger generations as well as adults, giving due consideration to the underprivileged, was essential in order to broaden the basis for an enlightened opinion and responsible conduct by

individuals, Enterprises and communities in protecting and improving the Environment in its full human dimension. It was also essential that mass media must avoid contributing to the deterioration of the Environment, but, on the contrary, disseminates information of an educational nature, on the need to protect and improve the Environment in order to enable man to develop in every respect.

20. Scientific research and development in the context of Environmental problems, both national and multi-national, were to be promoted in all countries, especially the developing countries. In this connection, the free flow of up-to-date scientific information and transfer of experience was to be supported and assisted to facilitate the solution of Environmental problems; Environmental technologies should be made available to developing countries on terms which would encourage their wide dissemination without constituting an economic burden on the developing countries.

2l. States had, in accordance with the Charter of United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own Environmental policies, and the responsibility to Insure that activities Within their jurisdiction or control did not cause damage to the Environment of other states or of areas beyond the limits of jurisdiction.

22. States were to cooperate to develop further the international law regarding liability and compensation for the victims of pollution and other Environmental damage caused by activities Within the jurisdiction or control of such states to areas beyond their jurisdiction.

23. Without prejudice to such criteria as might be agreed upon by the International commitment, or to standards which would have to be determined nationally, it was essential in all cases to consider the systems of values prevailing in each country, and the extent of the applicability of standards which were valid for the most advanced countries but which might be inappropriate and of unwarranted social cost of the developing countries.

24. International matters concerning the protection and improvement of the Environment should be handled in a cooperative spirit by all countries, big or small, on an equal footing. Cooperation through multilateral and bilateral arrangements or other appropriate means was essential to effectively control, prevent, reduce and eliminate adverse Environmental effects resulting from activities conducted in all spheres, in such a way that due account was taken to the sovereignty and interest of all states.

25. States were to ensure that international organization played a coordinated, efficient and dynamic role for the protection and improvement of the Environment.

26. Man and his Environment had to be spared the effects of nuclear weapons and all other means of mass destruction. States were to strive to reach prompt agreement, in the relevant international organs, on the elimination and complete destruction of such weapons.

Summary

1. Every person has the right to live in an Environment of quality. Everybody has the responsibility to protect and improve the Environment.
2. Environment is being degraded through pollution and depletion of natural resources.
3. Seas should not be used as dumping areas for pollutants. Marine life must be saved.
4. Every state should Insure that its pollutants do not spoil the Environment of other states, and
5. People should be educated about the causes of Environmental deterioration and modes of checking it.

Earth Summit -l992.

The United Nations Conference on Environment and Development (UNCED)s known as ‘Earth Summit-l992’ or ‘Rio Summit’. It was held at Rio de Janeiro, the capital of Brazil 3-l4 June l992 to Insure relationship between the Environment and development on a global partnership level. lt was a historic largest assembly of world leaders attended by l70 countries including ll5 Heads of states and Government officials. Between 3 and ll June l992 there were discussions among ministerial and official levels. Heads of States and Governments have met on l2-l4 June l992 and they exchanged their ideas and signed various declarations. On concluding day, l4th June l992 the Brazilian President, UN Secretary General and the UNCED Secretary General, Maurice F.Strong delivered their speeches at Rio.

Our Prime minister Sri P.V.Narasimha Rao had the honor of opening the three-day summit with a lucid speech on June l2, l992 in Rio de Janeiro. In a hard hitting and argumentative speech, he took recalcitrant nations, which were treating the issues of the Environment and development as subjects for political, posturing and bargaining. He argued that in a world of abundance, plenty brought pollution. There was also a world of want, where deprivation of degraded life.

The 2l issues negotiated in the earth summit were biodiversity, climate change, deforestation, Environmental health, marine resources, ozone holes, poverty, toxic wastes, urbanization etc. Due to opposition by religious groups and racial minorities the problem of population explosion was not discussed. The comprehensive 900-page document called ‘AgInda-2l' gives the practical action plan giving the policies, laws, institutional managements and treaties to carry out the provisions of the different treaties and conventions and became crucial in Insuring Environmental quality in 2l centuries.

Declarations and Conventions signed at the earth summit

Rio earth summit marked the 20th anniversary of the Stockholm Conference and the founding of the UNEP. The need for a scientific understanding of the phenomena like climate change, biodiversity and conservation of natural ecosystems including forests was the main object for this summit. The Heads of the States and Governments assembled at Rio to have the last chance to draw up an action plan, based on global partnership to save the earth planet for future generations. The following four crucial documents were adopted at the summit.

l. Rio declaration or a draft Earth chapter;
2. Conventions on Climate Change and Bio-diversity;
3.ConvIntions on Forestry, and
4. AgInda-2l or Action plan.

5. Rio declaration: Declaration with 27 guiding principles relates with the conservation, protection and restoration of health and integrity of the earth's ecosystem. The document also recognizes that "The polluter should bear the cost". It is estimated to cost about $ 625 billion to do away the damage done so far; the poorer nations need from developed countries. Many Environmentalists felt betrayed as the United States refused to sign the biodiversity treaties forest protection convention and also to donate new funds to poorer countries claiming that the conventions were too restrictive to American business and economy. Environmental protection agency chief William Reily, was critical on George Bush (Senior), then U.S. President for showing unwillingness to devote sufficient resources and time for meetings. One year later President Clinton signed various treaties (Which were rejected earlier by Bush) and allotted $l00 billion for population stabilization and Environmental protection and he is fully supported the theme of the summit "Sustainable Development".

6.Bio-diversity Convention: The main objective of the bio-diversity convention of the Earth summit are Conservation of biological diversity, sustainable use of biotic components. Fair and equitable sharing of the benefits arising out of the genetic resources, by appropriate access to genetic resources and by transfer of relevant technologies, taking into account all rights over those resources and the technologies and by appropriate funding.

Climate Change Convention: CCC of the earth summit announced the following objectives
(i) Stabilization of greenhouse gases at a level that would prevent dangerous anthropogenic interference with the climate system is to be achieved. (ii) Such a level should be achieved Within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to Insure that food production is not threatened and to Enable economic development to proceed in sustainable manner.

Principle
l. Human beings are at the center of the concerns for sustainable development. They are Entitled to a healthy and productive life in harmony with nature.

2. States have, in accordance with the charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own Environmental and developmental policies, and the responsibility to Insure that activities Within their jurisdiction or control do not cause damage to the Environment of other states or of areas beyond the limits of national jurisdiction.

3.The right to development must be fulfilled so as to equitably meet developmental and Environmental needs of present and future generations.

4.In order to achieve sustainable development, Environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it.

5.All states and all people shall cooperate in the essential task of eradicating poverty as an indispensable requirement for sustainable development, in order to decrease the disparities in standards of living and better meet the needs of the majority of the people of the world.

6.The special situation and needs of developing countries, particularly the least developed and those most Environmentally vulnerable, shall be given special priority. International actions in the field of Environment and development should also address the interests and needs of all countries.

7.States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity on the Earth's ecosystem. In view of the different contributions to global Environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global Environment and of the technologies and financial resources they command.

8.To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies.

9. States should cooperate to strengthen Endogenous capacity- building for sustainable development by improving scientific understanding through exchange of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies.

l0. Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the Environment that is held by public authorities, including information on hazardous materials and activities in their communities and the opportunity to participate in decision-making processes. States shall facilitate and Encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.

ll. States shall enact affective Environmental legislation. Environmental standards, management objectives and priorities should reflect the Environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries.

l2. States should cooperate to promote a supportive and open international economic system that would lead to economic growth and sustainable development in all countries, to better address the problems of Environmental degradation. Trade policy measures for Environmental purposes should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. Unilateral actions to deal with Environmental challenges outside the jurisdiction of the importing country should be avoided. Environmental measures addressing trans- boundary or global Environmental problems should, as far as possible, be based on an international consensus.

l3. State shall develop national law regarding liability and compensation for the victims of pollution and other Environmental damage. States shall also cooperate in an expeditious and more determined manner to develop further international law regarding liability and compensation for adverse effects of Environmental damage caused by activities Within their jurisdiction or control to areas beyond their jurisdiction.

l4. States should effectively cooperate to discourage or prevent the relocation and transfer to other states of any activities and substances that because severe Environmental degradation is found to be harmful to human health.

l5. In order to protect the Environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent Environmental degradation.
l6. National authorities should endeavor to promote the internationalization of Environmental costs and the use of economic instruments, taking into account approach that the polluter should, in principle bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.

l7.Environmental impact Assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the Environment and are subject to a decision of competent national authority.

l8. States shall immediately notify other states of any natural disaster or other emergencies that are likely to produce sudden harmful effects on the Environment of those states. Every effort shall be made by the international community to help States so afflicted.

l9. States shall provide prior and timely notification and relevant information to potentially effected States on activities that may have a significant adverse trans boundary Environmental effect and shall consult with those states at an early stage and in good faith.

20. Women have a vital role in Environmental management and development. Their full participations, therefore, essential to achieve sustainable development and Insure for a better future for all.

2l. The creativity, ideals of courage of the youth of the world should be mobilized to forge a global partnership in order to achieve sustainable development and Insure a better future for all.

22. Indigenous people and their communities and other local communities have a vital role in Environmental management and development because of their knowledge and traditional practices. States should recognize and duly support their identity, culture and interests and enable their effective participation in the achievement of sustainable development.

23. The Environment and natural resources of people under oppression, domination and occupation shall be protected.

24. Warfare is inherently destructive of sustained development. States shall, therefore, respect international law providing protection for the Environment in times of armed conflict and cooperate in its further development, as necessary.

25. Peace, development and Environmental protection are inter-dependent and indivisible.

26. States shall resolve all their Environmental disputes peacefully and by appropriate means in accordance with the charter of the United Nations.

27. States and people shall cooperate good faith and in a spirit of partnership in the fulfillment of the principles embodied in this declaration and in further development of international law in the field of sustainable development.

Ecosystems

Concept Of Ecosystem

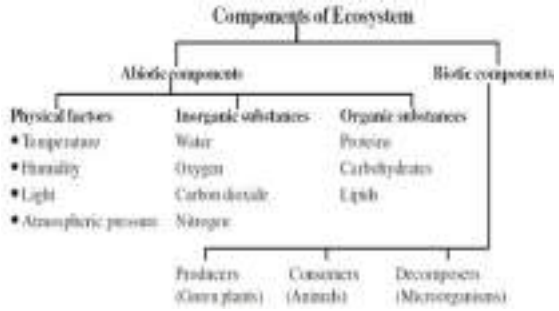
Various kinds of life supporting systems like the forests, grasslands, oceans, lakes, rivers, mountains, deserts and estuaries show wide variations in their structural composition and functions. However, they all are alike in the fact that they consist of living Entities interacting with their surroundings exchanging matter and Energy. How do these different units like a hot desert, a dense evergreen forest, the Antarctic Sea or a shallow pond differ in the type of their flora and fauna, how do they derive their Energy and nutrients to live together, how do they influence each other and regulate their stability are the questions that are answered by Ecology. The term Ecology was coined by Earnest Haeckel in l869. It is derived from the Greek words Oikos- home + logos- study. So ecology deals with the study of organisms in their natural home interacting with their surroundings. The surroundings or Environment consists of other living organisms (biotic) and physical (abiotic) components. Modern ecologists believe that an adequate definition of ecology must specify some unit of study and one such basic unit described by Tansley (l935) was ecosystem. An ecosystem is a group of biotic communities of species interacting with one another and with their non-living Environment exchanging Energy and matter. Now ecology is often defined as .the study of ecosystems.. An ecosystem is an integrated unit consisting of interacting plants, animals and microorganisms whose survival depends upon the maintenance and regulation of their biotic and abiotic structures and functions . The ecosystem is thus, a unit or a system which is composed of a number of subunits, that are all directly or indirectly linked with each other . They may be freely exchanging Energy and matter from outside-an open ecosystem or may be isolated from outside-a closed ecosystem .

COMPONENTS OF AN ECOSYSTEM

They are broadly grouped into:-

(a) Abiotic and

(b) Biotic components



(a) Abiotic components (Nonliving): The abiotic component can be grouped into following three categories:-
(i) Physical factors: Sun light, temperature, rainfall, humidity and pressure. They sustain and limit the growth of organisms in an ecosystem.
(ii) Inorganic substances: Carbon dioxide, nitrogen, oxygen, phosphorus, sulphur, water, rock, soil and other minerals.
(iii) Organic compounds: Carbohydrates, proteins, lipids and humic substances. They are the building blocks of living systems and therefore, make a link between the biotic and abiotic components.

(b) Biotic components (Living)
(i) Producers: The green plants manufacture food for the Entire ecosystem through the process of photosynthesis. Green plants are called autotrophs, as they absorb water and nutrients from the soil, carbon dioxide from the air, and capture solar Energy for this process.
(ii) Consumers: They are called heterotrophs and they consume food synthesized by the autotrophs. Based on food preferences they can be grouped into three broad categories. Herbivores (e.g. cow, deer and rabbit etc.) feed directly on plants, carnivores are animals which eat other animals (eg. lion, cat, dog etc.) and omnivores organisms feeding upon both plants and animals e.g. human, pigs and sparrow.
(iii) Decomposers: Also called saprotrophs . These are mostly bacteria and fungi that feed on dead decomposed and the dead organic matter of plants and animals by secreting Enzymes outside their body on the decaying matter. They play a very important role in recycling of nutrients. They are also called detrivores or detritus feeders. Functions of ecosystem
Ecosystems are complex dynamic system. They perform certain functions. These are:-

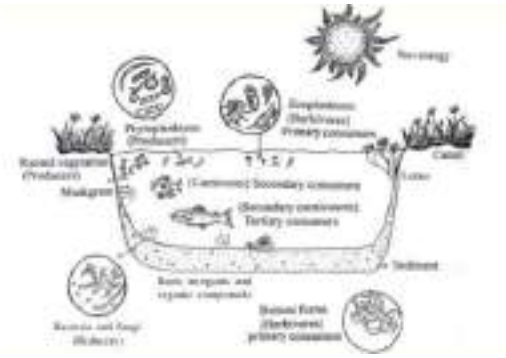
(i) Energy flow through food chain
(ii) Nutrient cycling (biogeochemical cycles)
(iii) Ecological succession or ecosystem development
(iv) Homeostasis (or cybernetic) or feedback control mechanisms Ponds, lakes, meadows, marshlands, grasslands, deserts and forests are examples of natural ecosystem. Many of you have seen an aquarium; a garden or a lawn etc. in your neighborhood. These are man made ecosystem.

TYPES OF ECOSYSTEMS

Ecosystems are classified as follows:
(i) Natural ecosystems (ii) Man made ecosystems
(i) Natural ecosystems
(a) Totally dependent on solar radiation e.g. forests, grasslands, oceans, lakes, rivers and deserts. They provide food, fuel, fodder and medicines.
(b) Ecosystems dependent on solar radiation and Energy subsidies (alternative sources) such as wind, rain and tides. Eg. tropical rain forests, tidal estuaries and coral reefs.

Pond Ecosystem

A pond is an example of a complete, closed and an independent ecosystem. It is convenient to study its basic structure and functions. It works on solar Energy and maintains its biotic community in equilibrium. If you collect a glass full of pond water or a scoop full of pond bottom mud, it consists of a mixture of plants, animals, inorganic and organic materials. Following components are found in a pond ecosystem



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(a) Abiotic components

(i) Light: Solar radiation provides Energy that controls the Entire system. Penetration of light depends on transparency of water, amount of dissolved or suspended particles in water and the number of plankton. On the basis of extent of Penetration of light a pond can be divided into euphotic (eu=true,photic=light), mesophotic and aphotic zones. Plenty of light is available to plants and animals in euphotic zone. No light is available in the aphotic zone. (ii) Inorganic substances: These are water, carbon, nitrogen, phosphorus, calcium and a few other elements like sulphur depending on the location of the pond. The inorganic substances like O2 and CO2 are in dissolved state in water. All plants and animals depend on water for their food and exchange of gases- nitrogen, phosphorus, sulphur and other inorganic salts are held in reserve in bottom sediment and inside the living organisms. A very small fraction may be in the dissolved state.

(iii) Organic compounds: The commonly found organic matter in the pond are amino acids and humic acids and the breakdown products of dead animals and plants. They are partly dissolved in water and partly suspended in water.

(b) Biotic components

(i) Producers or autotrophs: synthesize food for all the heterotrophs of the pond. They can be categorized into two groups:-

(a) Floating microorganisms and plants

(b) Rooted plants

(a) Floating microorganisms (green) and plants are called phytoplankton ("phyto"- plants, "plankton" –floating). They are microscopic organisms. Sometimes they are so abundant in pond that they make it look green in colour e.g. Spirogyra, Ulothrix, Cladophora, Diatoms, Volvox.

(b) Rooted plants: These are arranged in concentric zones from periphery to the deeper layers. Three distinct zones of aquatic plants can be seen with increasing depth of water in the following order:

i) Zone of emergent vegetation: . eg. Typha, Bulrushes and Sagittaria

ii) Zone of rooted vegetation with floating leaves . eg. Nymphaea

iii) Zone of submergent vegetation: eg. All pond weeds like Hydrilla , Rupia, musk grass etc.

(ii) Consumers /Heterotrophs are animals which feed directly or indirectly on autotrophs

eg. Tadpole, snails, sunfish, bass etc. Pond animals can be classified into the following groups

(a) Zooplanktons are floating animals. Cyclops, Cypris

(b) Nektons are the animals that can swim and navigate at will. Eg. fishes

(c) Benthic animals are the bottom dwellers: beetle, mites, mollusks and some crustaceans.

(iii) Decomposers: They are distributed throughout the Entire in the whole pond but in the sediment most abundant. There are bacteria and fungi. (Rhizopus, PInicillium, Curvularia , Cladosporium) found at the bottom of the pond.

Forest Ecosystem

These are the ecosystems having a predominance of trees that are interspersed with a large number of species of herbs, shrubs, climbers, lichens, algae and a wide variety of wild animals and birds. As discussed above forests are found in

undisturbed areas receiving moderate to high rainfall and usually occur as stable climax communities. Depending upon the prevailing climatic conditions forests can be of various types:

(a) Tropical Rain Forests: They are evergreen broadleaf forests found near the equator. They are characterized by high temperature, high humidity and high rainfall, all of which favor the growth of trees. All through the year the climate remains more or less uniform. They are the richest in biodiversity. Different forms of life occupy specialized areas (niches) Within different layers and spaces of the ecosystem depending upon their needs for food, sunlight, water, Nutrient etc. We come across different types and layers of plants and animals in the tropical rain forests. e.g. the emergent layer is the topmost layer of the tallest broad-leaf evergreen trees, below which lies the canopy where top branches of shorter trees form an umbrella like cover. Below this is present the under story of still smaller trees. On the tree trunks some woody climbers are found to grow which are known as Lianas. There are some other plants like Orchids which are epiphytes i.e. they are attached to the trunks or branches of big trees and they take up water and nutrients falling from above. The orchids have special type of leaves to capture and hold the water. Some large epiphytes can hold as much as 4litres of water, equivalent to a small bucket! Thus, these epiphytes almost act like mini-ponds suspended up in the air, in the forest crown. That is the reason why a large variety of birds, insects and animals like monkeys have made their natural homes (habitats) in these forests (Plate II). The under storey trees usually receive very dim sunlight. They usually develop dark green leaves with high chlorophyll content so that they can use the diffused sunlight for photosynthesis. The shrub layer receives Even less sunlight and the ground layer commonly known as forest floor receives almost no sunlight and is a dark layer. Most of the animals like bats, birds, insects etc. occupy the bright canopy layer while monkeys, toads, snakes, chameleons etc. keep on moving up and down in sunny and darker layers. Termites, fungi, mushrooms etc. grow on the ground layer. Warm temperature and high availability of moisture facilitate rapid breakdown (decomposition) of the dropped leaves, twigs etc. releasing the nutrients rapidly. These nutrients are immediately taken up by the mycorrhizal roots of the trees.

Interestingly, the flowers of forest trees are very large, colourful, fragrant and attractive which helps in pollination by insects, birds, bats etc. Rafflesia arnoldi, the biggest flower (7 kg weight) is known to smell like rotten meat and attracts flies and beetles which help in its pollination (Plate III).

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The Silent Valley in Kerala is the only tropical rain forest lying in India which is the natural habitat for a wide variety of species. Being the storehouse of biodiversity, the forests provide us with an array of commercial goods like timber, fuel wood, drugs, resins, gums etc. Unfortunately there is cutting down of these forests at an alarming rate. Within the next 30-40 years we are likely to be left with only scattered fragments of such forests, thereby losing the rich biodiversity and the ecological uses of forests.

(b) Tropical deciduous forests: They are found a little away from the equator and are characterized by a warm climate the year round. Rain occurs only during monsoon. A large part of the year remains dry and therefore different types of deciduous trees are found here, which lose their leaves during dry season.

(c) Tropical scrub forests: They are found in areas where the dry season is Even longer. Here there are small deciduous trees and shrubs.

(d) Temperate rain forests: They are found in temperate areas with adequate rainfall. These are dominated by coniferous trees like pines, firs, redwoods etc. They also consist of some evergreen broadleaf trees.

(e) Temperate deciduous forests: They are found in areas with moderate temperatures. There is a marked seasonality with long summers, cold but not too severe winter and abundant rainfall throughout the year. The major trees include broad leaf deciduous trees like oak, hickory, poplar etc.

(f) Evergreen coniferous forests (Boreal Forests): They are found just south of arctic tundra. Here winters are long, cold and dry. Sunlight is available for a few hours only. In summer the temperature is mild, sun-shines for long hours but the season is quite short. The major trees include pines, spruce, fir, cedar etc. which have tiny, needle-shaped leaves having a waxy coating so that they can withstand severe cold and drought. The soil is found to get frozen during winter when few species can survive. The leaves, also know as needles, fall on the forest floor and cover the Nutrient poor soil. These soils are acidic and prevent other plants from growing. Species diversity is rather low in these forests

UNIT-2: Environment and Natural Resources Management

FOREST RESOURCES

Uses Of Forests:

Commercial uses: Forests provide us a large number of commercial goods which include timber, firewood, pulpwood, food items, gum, resins, non-edible oils, rubber, fibers, lac, bamboo canes, fodder, medicine, drugs and many more items, the total worth of which is estimated to be more than $ 300 billion per year. Half of the timber cut each year is used as fuel for heating and cooking. One third of the wood harvest is used for building materials as lumber, plywood and hardwood, particle board and chipboard. One sixth of the wood harvest is converted into pulp and used for paper industry. Many forest lands are used for mining, agriculture, grazing, and recreation and for development of dams. Ecological uses: While a typical tree produces commercial goods worth about $ 590 it provides Environmental services worth nearly $ l96, 250. The ecological services provided by our forests may be summed up as follows:

Production of oxygen:

The trees produce oxygen by photosynthesis which is so vital for life on this earth. They are rightly called as earth's lungs. Reducing global warming: The main greenhouse gas carbon dioxide (CO_2) is absorbed by the forests as a raw material for photosynthesis. Thus forest canopy acts as a sink for CO_2 thereby reducing the problem of global warming caused by greenhouse gas CO_2. Wild life habitat: Forests are the homes of millions of wild animals and plants. About 7 million species are found in the tropical forests alone.

Regulation of hydrological cycle:

Forested watersheds act like giant sponges, absorbing the rainfall, slowing down the runoff and slowly releasing the water for recharge of springs. About 50-80 %of the moisture in the air above tropical forests comes from their transpiration which helps in bringing rains.

Soil Conservation:

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

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

OVER EXPLOITATION OF FORESTS

Since time immemorial, humans have depended heavily on forests for food, medicine, shelter, wood and fuel. With growing civilization the demands for raw material like timber, pulp, minerals, fuel wood etc. shooted up resulting in large scale logging, mining, road-building and clearing of forests. Our forests contribute substantially to the national economy. The international timber trade alone is worth over US $ 40 billion per year. Excessive use of fuel wood and charcoal, expansion of urban, agricultural and industrial areas and overgrazing have together led to over-exploitation of our forests leading to their rapid degradation.

DEFORESTATION

The total forest area of the world in l900 was estimated to be 7,000 million hectares which was reduced to 2890 million ha in l975 and fell down to just 2,300 million ha by 2000. Deforestation rate is relatively less in temperate countries, but it is very alarming in tropical countries where it is as high as 40-50 percent and at the present rate it is estimated that in the next 60 years we would lose more than 90 percent of our tropical forests. The forested area in India seems to have stabilized since l982 with about 0.04% decline annually between l982-90. FAO (l983) estimated that about l.44 m ha of land was brought under afforestation during this period leading to stabilization. As per FAO estimates, the deforestation rate per unit population in India is the lowest amongst the major tropical countries, despite the fact that we have a huge population size and very low per capita forest area (0.075 ha per capita). However, we are still far behind the target of achieveng 33% forest area, as per our National Forest Policy, as we are still having only l9.27 % of our land area (63.38m ha) covered by forests based on satellite data (MoEF, l998).

Major Causes of Deforestation

Shifting cultivation:

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

Fuel requirements:

Increasing demands for fuel wood by the growing population in India alone has shooted up to 300-500 million tons in 200l as compared to just 65 million tons during independence, thereby increasing the pressure on forests.

Raw materials for industrial use:

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

Development projects:

Massive destruction of forests occur for various development projects like hydroelectric projects, big dams, road construction, mining etc.

Growing food needs:

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

Overgrazing:

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

Dams And Their Effects On Forests And People

Big dams and river valley projects have multi-purpose uses and have been referred to as .Temples of modern India.. However, these dams are also responsible for the destruction of vast areas of forests. India has more than l550 large dams, the maximum being in the state of Maharashtra (more then 600), followed by Gujarat (more then 250) and Madhya Pradesh (l30). The highest one is Tehri dam, on river Bhagirathi in Uttaranchal and the largest in terms of capacity is Bhakra dam on river Satluj in H.P. Big dams have been in sharp focus of various Environmental groups all over the world which is mainly because of several ecological problems including deforestation and socio-economic problems related to tribal or native people associated with them. The Silent Valley hydroelectric project was one of the first such projects situated in the tropical rain forest area of Western Ghats which attracted much concern of the people. The crusade against the ecological damage and deforestation caused due to Tehri dam was led by Sh. Sunder lal Bahuguna, the leader of Chipko movement. The cause of Sardar Sarovar Dam related issues has been taken up by the Environmental activists Medha Patekar, joined by Arundhati Ray and Baba Amte. For building big dams, large scale devastation of forests takes place which breaks the natural ecological balance of the region. Floods, droughts and landslides become more prevalentent in such areas. Forests are the repositories of invaluable gifts of nature in the form of biodiversity and by destroying them (particularly, the tropical rain forests) we are going to lose these species Even before knowing them. These species could be having marvelous economic or medicinal value and deforestation results in loss of this storehouse of species which have evolved over millions of years in a single stroke

Land resources

Overgrazing :

Livestock wealth plays a crucial role in the rural life of our country. India leads in live stock population in the world. The huge population of livestock needs to be fed and the grazing lands or pasture areas are not adequate. Very often we find that the live stock grazing on a particular piece of grassland or pasture surpass the carrying capacity.

Carrying capacity of any system is the maximum population that can be supported by it on a sustainable basis. However, most often, the grazing pressure is so high that its carrying capacity is crossed and the sustainability of the grazing lands fails. Let us see what are the impacts of overgrazing.

Impacts of Overgrazing

(i) Land Degradation:

Overgrazing removes the vegetal cover over the soil and the exposed soil gets compacted due to which the operative soil depth declines. So the roots cannot go much deep into the soil and adequate soil moisture is not available. Organic recycling also declines in the ecosystem because not enough detritus or litter remains on the soil to be decomposed.

The humus content of the soil decreases and overgrazing leads to organically poor, dry, compacted soil. Due to trampling by cattle the soil loses infiltration capacity, which reduces percolation of water into the soil and as a result of this more water gets lost from the ecosystem along with surface run off. Thus over grazing leads to multiple actions resulting in loss of soil structure, hydraulic conductivity and soil fertility.

(ii) Soil Erosion: Due to overgrazing by cattle, the cover of vegetation almost gets removed from the land. The soil becomes exposed and gets eroded by the action of strong wind, rainfall etc. The grass roots are very good binders of soil. When the grasses are removed, the soil becomes loose and susceptible to the action of wind and water.

(iii) Loss of useful species:

Overgrazing adversely affects the composition of plant population and their regeneration capacity. The original grassland consists of good quality grasses and forbs with high nutritive value. When the

Livestock graze upon them heavily, Even the root stocks which carry the reserve food for regeneration get destroyed. Now some other species appear in their place. These secondary species are hardier and are less nutritive in nature.

Some livestock keep on overgrazing on these species also. Ultimately the nutritious, juicy fodder giveng species like Cenchrus, Dichanthium, Panicum and Heteropogon etc. are replaced by unpalatable and sometimes thorny plants like Parthenium, Lantana, Xanthium etc. These species do not have a good capacity of binding the soil particles and, therefore, the soil becomes more prone to soil erosion.

As a result of overgrazing vast areas in Arunachal Pradesh and Meghalaya are getting invaded by thorny bushes, weeds etc. of low fodder value. Thus overgrazing makes the grazing land lose its regenerating capacity and once good quality pasture land gets converted into an ecosystem with poor quality thorny vegetation.

Agriculture:

- In the early years of human existence on this earth, man was just a hunter gatherer and was quite like other animal species. Some l0,000 to l2,000 years ago he took to agriculture by cultivating plants of his own choice. He used the practice of Slash and burn cultivation or shifting cultivation, which is still prevalentent in many tribal areas, as in the North East Hills of India. The type of agriculture practiced these days is very different from the traditional ones and their outputs in terms of yield as well as their impacts on the Environment show lots of differences.

l. Traditional agriculture and its impacts:

It usually involves a small plot, simple tools, naturally available water, organic fertilizer and a mix of crops. It is more near to natural conditions and usually it results in low production. It is still practiced by about half the global population. The main impacts of this type of agriculture are as follows:

Deforestation:

The slash and burn of trees in forests to clear the land for cultivation and frequent shifting result in loss of forest cover.

Soil erosion:

Clearing of forest cover exposes the soil to wind, rain and storms, thereby resulting in loss of top fertile layer of soil.

(iii) Depletion of nutrients:

During slash and burn the organic matter in the soil gets destroyed and most of the nutrients are taken up by the crops Within a short period, thus making the soil Nutrient poor which makes the cultivators shift to another area.

Modern Agriculture and its impacts:

It makes use of hybrid seeds of selected and single crop variety, high-tech equipments and lots of Energy subsidies in the form of fertilizers, pesticides and irrigation water. The food production has increased tremendously, evidenced by “green revolution”. However, it also gave rise to several problematic off-shoots as discussed below:

(i) Impacts related to high yielding varieties (HYV):

The uses of HYVs Encourage monoculture i.e. the same genotype is grown over vast areas. In case of an attack by some pathogen, there is total devastation of the crop by the disease due to exactly uniform conditions, which help in rapid spread of the disease.

(ii) Fertilizer related problems:

(a) Micronutrient imbalance:

Most of the chemical fertilizers used in modern agriculture have nitrogen, phosphorus and potassium (N, P, K) which are essential macronutrients. Farmers usually use these fertilizers indiscriminately to boost up crop growth. Excessive use of fertilizers cause micronutrient imbalance. For example, excessive fertilizer use in Punjab and Haryana has caused deficiency of the micronutrient zinc in the soils, which is affecting productivity of the soil.

(b) Nitrate Pollution:
Nitrogenous fertilizers applied in the fields often leach deep into the soil and ultimately contaminate the ground water. The nitrates get concentrated in the water and when their concentration exceeds 25 mg/L, they become the cause of a serious health hazard called "Blue Baby Syndrome" or methaemoglobinemia. This disease affects the infants to the maximum extent causing Even death. In Denmark, England, France, Germany and Netherlands this problem is quite prevalentent. In India also, problem of nitrate pollution exists in many areas.

(c) Eutrophication:
Excessive use of N and P fertilizers in the agricultural fields leads to another problem, which is not related to the soil, but relates to water bodies like lakes. A large proportion of nitrogen and phosphorus used in crop fields is washed off and along with runoff water reach the water bodies causing over nourishment of the lakes, a process known as Eutrophication (eu=more, trophic=nutrition).
Due to eutrophication the lakes get invaded by algal blooms. These algal species grow very fast by rapidly using up the nutrients. They are often toxic and badly affect the food chain. The algal species quickly complete their life cycle and die thereby adding a lot of dead organic matter. The fishes are also killed and there is a lot of dead matter that starts getting decomposed.
Oxygen is consumed in the process of decomposition and very soon the water gets depleted of dissolved oxygen. This further affects aquatic fauna and ultimately anaerobic conditions are created where only pathogenic anaerobic bacteria can survive. Thus, due to excessive use of fertilizers in the agricultural fields the lake ecosystem gets degraded. This shows how an unmindful action can have far reaching impacts.

(iii) Pesticide related problems:
Thousands of types of pesticides are used in agriculture. The first generation pesticides include chemicals like sulphur, arsenic, lead or mercury to kill the pests. DDT (Dichlorodiphenyl trichloroethane) whose insecticidal properties were discovered by Paul Mueller in l939 belongs to the second generation pesticides. After l940, a large number of synthetic pesticides came into use. Although these pesticides have gone a long way in protecting our crops from huge losses occurring due to pests, yet they have a number of side-effects, as discussed below:
(a) Creating resistance in pests and producing new pests: Some individuals of the pest species usually survive Even after pesticide spray. The survivors give rise to highly resistant generations. About 20 species of pests are now known which have become immune to all types of pesticides and are known as ""Super pests".
(b) Death of non-target organisms: Many insecticides are broad spectrum poisons which not only kill the target species but also several non-target species that are useful to us.

(c) **Biological magnification:** Many of the pesticides are non biodegradable and keep on accumulating in the food chain, a process called biological magnification. Since human beings occupy a high trophic level in the food chain, hence they get the pesticides in a bio-magnified form which is very harmful.

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

(v) Salinity problem: At present one third of the total cultivable land area of the world is affected by salts. In India about seven million hectares of land are estimated to be salt—affected which may be saline or sodic. Saline soils are characterized by the accumulation of soluble salts like sodium chloride, sodium sulphate, calcium chloride, magnesium chloride etc. in the soil profile. Their electrical conductivity is more than 4 ds/m. Sodic soils have carbonates and bicarbonates of sodium, the pH usually exceeds 8.0 and the exchangeable sodium percentage (ESP) is more than l5%.Causes.
A Major cause of salinization of soil is excessive irrigation. About 20% of the world's croplands receive irrigation with canal water or ground water which unlike rainwater often contains dissolved salts. Under dry climates, the water evaporates leaving behind salts in the upper soil profile Thousands of hectares of land area in Haryana and Punjab are affected by soil salinity and alkalinity. Salinity causes stunted plant growth and lowers crop yield. Most of the crops cannot tolerate high salinity

Remedy: The most common method for getting rid of salts is to flush them out by applying more good quality water to such soils. Another method is laying underground network of perforated drainage pipes for flushing out the salts slowly. This sub-

surface drainage system has been tried in the experimental station of CSSRI at Sampla, Haryana. The Central Soil Salinity Research Institute (CSSRI) located in Karnal, Haryana has to its achievement the success story of converting Zarifa Viran village to Zarifa Abad i.e. 'from the barren land to productive land' through its research applications.

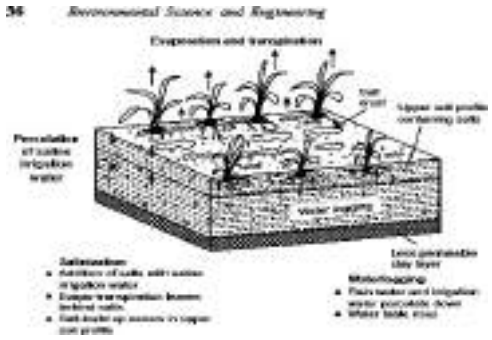


Fig. Salinization and water logging

ENERGY RESOURCES

Energy consumption of a nation is usually considered as an index of its development. This is because almost all the developmental activities are directly or indirectly dependent upon Energy. We find wide disparities in per capita Energy use between the developed and the developing nations. The first form of Energy technology probably was the fire, which produced heat and the early man used it for cooking and heating purposes. Wind and hydropower have also been in use for the last l0,000 years. The invention of steam Engenes replaced the burning of wood by coal and coal was later replaced to a great extent by oil. In l970.s due to Iranian revolution and Arab oil embargo the prices of oil shooted up. This ultimately led to exploration and use of several alternate sources of Energy.

GROWING ENERGY NEEDS:

Development in different sectors relies largely upon Energy. Agriculture, industry, mining, transportation, lighting, cooling and heating in buildings all need Energy. With the demands of growing population the world is facing further Energy deficit. The fossil fuels like coal, oil and natural gas which at present are supplying 95% of the commercial Energy of the world resources and are not going to last for many more years. Our life style is changing very fast and from a simple way of life we are shifting to a luxurious life style. If you just look at the number of electric gadgets in your homes and the number of private cars and scooters in your locality you will realize that in the last few years they have multiplied many folds and all of them consume Energy.

Developed countries like U.S.A. and Canada constitute about 5% of the world's population but consume one fourth of global Energy resources. An average person there consumes 300 GJ (Giga Joules, equal to 60 barrels of oils) per year. By contrast, an average man in a poor country like Bhutan, Nepal or Ethiopia consumes less than l GJ in a year. So a person in a rich country consumes almost as much Energy in a single day as one person does in a whole year in a poor country. This clearly shows that our life-style and standard of living are closely related to Energy needs. Fig. 2.5.l shows the strong correlation between per capita Energy use and GNP (Gross National product). U.S.A., Norway, Switzerland etc. with high GNP show high Energy use while India, China etc have low GNP and low Energy use. Bahrain and Quatarare oil rich states (UAE) and hence their Energy consumption and GNP are more, although their development is not that high.

Renewable And Non-Renewable Energy Sources

A source of Energy is one that can provide adequate amount of Energy in a usable form over a long period of time. These sources can be of two types:

(l)Renewable Resources which can be generated continuously in nature and are inexhaustible e.g. wood, solar Energy, wind Energy, tidal Energy, hydropower, biomass Energy, bio-fuels, geo-thermal Energy and hydrogen. They are also known as non-conventional sources of Energy and they can be used again and again in an endless manner.

(2) Non-Renewable Resources which have accumulated in nature over a long span of time and cannot be quickly replenished when exhausted e.g. coal, petroleum, natural gas and nuclear fuels like uranium and thorium. Wood is a Renewable resource as we can get new wood by growing a sapling into a tree Within l5-20 years but it has taken millions of years for the formation of coal from trees and cannot be regenerated in our life time, hence coal is not Renewable. We will now discuss various forms of Renewable and non-Renewable Energy resource.

(a) Renewable Energy Resources

Solar Energy:

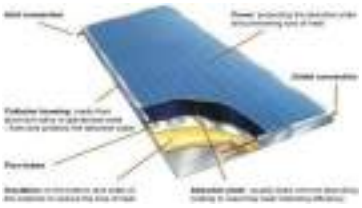
Sun is the ultimate source of Energy, directly or indirectly for all other forms of Energy. The nuclear fusion reactions occurring inside the sun release enormous quantities of Energy in the form of heat and light. The solar Energy received by the near earth space is approximately l.4 kilojoules/second/m2 known as solar constant. Traditionally, we have been using solar Energy for drying clothes and food-grains, preservation of eatables and for obtaining salt from sea-water. Now we have several techniques for harnessing solar Energy Some important solar Energy harvesting devices are discussed here.

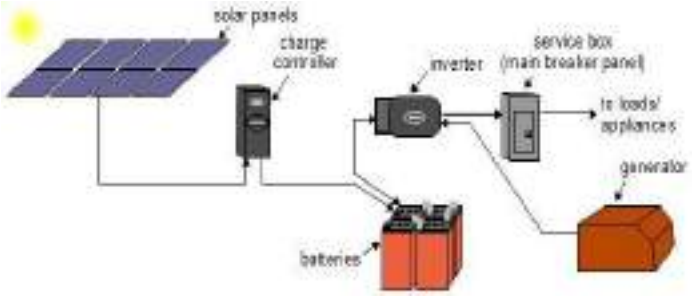
(i) Solar heat collectors: These can be passive or active in nature. Passive solar heat collectors are natural materials like stones, bricks etc. or material like glass which absorb heat during the day time and release it slowly at night. Active solar collectors pump a heat absorbing medium (air or water) through a small collector which is normally placed on the top of thebuilding.

(ii) Solar cells: They are also known as photovoltaic cells or PV cells. Solar cells are made of then wafers of semi conductor materials like silicon and gallium. When solar radiations fall on them, a potential difference is produced which causes flow of electrons and produces electricity. Silicon can be obtained from silica or sand, which is abundantly available and inexpIosive. By using gallium arsenide, cadmium sulphide or boron, efficiency of the PV cells can be improved.
The potential difference produced by a single PV cell of 4 cm2 size is about 0.4-0.5 volts and produces a current of 60 milli amperes. A group of solar cells joined together in a definite pattern form a solar panel which can harness a large amount of solar Energy and can produce electricity Enough to run street-light, irrigation water pump etc. Solar cells are widely used in calculators, electronic watches, street lighting, traffic signals, water pumps etc. They are also used in artificial satellites for electricity generation. Solar cells are used for running radio and television also. They are more in use in remote areas where conventional electricity supply is a problem.

(iii) Solar cooker: Solar cookers make use of solar heat by reflecting the solar radiations using a mirror directly on to a glass sheet which covers the black insulated box Within which the raw food is kept. A new design of solar cooker is now available which involves a spherical reflector (concave or parabolic reflector) instead of plane mirror that has more heating effect and hence greater efficiency. The food cooked in solar cookers is more nutritious due to slow heating. However it has the limitation that it cannot be used at night or on cloudy days. Moreover, the direction of the cooker has to be adjusted according to the direction of the sun rays.

(iv) Solar water heater: It consists of an insulated box painted black from inside and having a glass lid to receive and store solar heat. Inside the box it has black painted copper coil through which cold water is made to flow in, which gets heated and flows out into a storage tank. The hot water from the storage tank fitted on roof top is then supplied through pipes into buildings like hotels and hospitals. (v) Solar furnace: Here thousands of small plane mirrors are arranged in concave reflectors, all of which collect the solar heat and produce as high a temperature as 3000°C. (vi) Solar power plant: Solar Energy is harnessed on a large scale by using concave reflectors which cause boiling of water to produce steam. The steam turbine drives a generator to produce electricity. A solar power plant (50 K Watt capacity) has been installed at Gurgaon, Haryana.



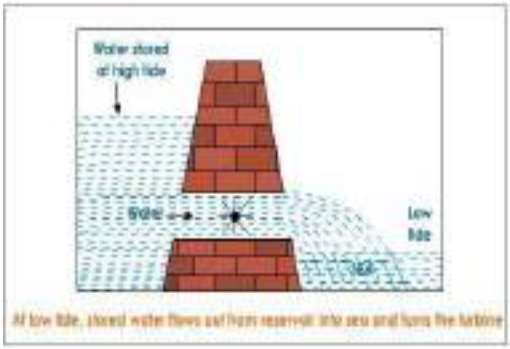


WIND ENERGY

The high speed winds have a lot of Energy in them as kinetic Energy due to their motion. The driving force of the winds is the sun. The wind Energy is harnessed by making use of wind mills. The blades of the wind mill keep on rotating continuously due to the force of the striking wind. The rotational motion of the blades drives a number of machines like water pumps, flour mills and electric generators. A large number of wind mills are installed in clusters called wind farms, which feed power to the utility grid and produce a large amount of electricity. These farms are ideally located in coastal regions, open grasslands or hilly regions, particularly mountain passes and ridges where the winds are strong and steady. The minimum wind speed required for satisfactory working of a wind generator is l5 km/hr. The wind power potential of our country is estimated to be about 20,000 MW, while at present we are generating about l020 MW. The largest wind farm of our country is near Kanyakumari in Tamil Nadu generating 380 MW electricity. Wind Energy is very useful as it does not cause any air pollution.

After the initial installation cost, the wind Energy is very cheap. It is believed that by the middle of the century wind power would supply more than l0% of world's electricity. HYDROPOWER The water flowing in a river is collected by constructing a big dam where the water is stored and allowed to fall from a height. The blades of the turbine located at the bottom of the dam move with the fast moving water which in turn rotate the generator and produces electricity. We can also construct mini or micro hydel power plants on the rivers in hilly regions for harnessing the hydro Energy on a small scale, but the minimum height of the water falls should be l0 meters. The hydropower potential of India is estimated to be about 4 × l0ll KW-hours. Till now we have utilized only a little more than ll% of this potential. Hydropower does not cause any pollution, it is Renewable and normally the hydro power projects are multi-purpose projects helping in controlling floods, used for irrigation, navigation etc. However, big dams are often associated with a number of Environmental impacts which have already been discussed in the previous section.

TIDAL ENERGY



Ocean tides produced by gravitational forces of sun and moon contain Enormous amounts of Energy. The .high tide. and .low tide. refer to the rise and fall of water in the oceans. A difference of several meters is required between the height of high and low tide to spin the turbines. The tidal Energy can be harnessed by constructing a tidal barrage. During high tide, the sea-water flows into the reservoir of the barrage and turns the turbine, which in turn produces electricity by rotating the generators. During low tide, when the sea-level is low, the sea water stored in the barrage reservoir flows out into the sea and again turns the turbines.

There are only a few sites in the world where tidal Energy can be suitably harnessed. The bay of Fundy Canada having l7-l8 m high tides has a potential of 5,000 MW of power generation. The tidal mill at La Rance, France is one of the first modern tidal power mill. In India Gulf of Cambay, Gulf of Kutch and the Sunder bans deltas are the tidal power sites.

OCEAN THERMAL ENERGY (OTE)

The Energy available due to the difference in temperature of water at the surface of the tropical oceans and at deeper levels is called Ocean Thermal Energy. A difference of 20°C or more is required between surface water and deeper water of ocean for operating OTEC (Ocean Thermal Energy Conversion) power plants. The warm surface water of ocean is used to boil a liquid like ammonia. The high pressure vapours of the liquid formed by boiling are then used to turn the turbine of a generator and

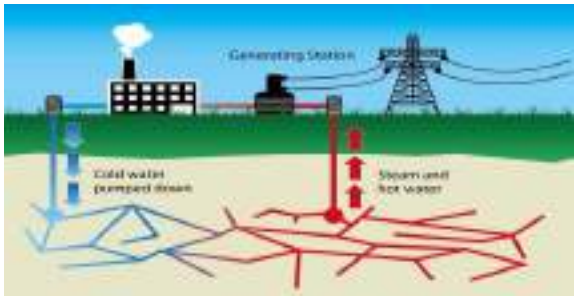
produce electricity. The colder water from the deeper oceans is pumped to cool and condense the vapours into liquid. Thus the process keeps on going continuously for 24 hours a day.

HYDROPOWER

The water flowing in a river is collected by constructing a big dam here the water is stored and allowed to fall from a height. The blades of the turbine located at the bottom of the dam move with the fast moving water which in turn rotate the generator and produces electricity. We can also construct mini or micro hydel power plants on the rivers in hilly regions for harnessing the hydro Energy on a small scale, but the minimum height of the water falls should be l0 metres. The hydropower potential of India is estimated to be about 4 × l0ll KW-hours. Till now we have utilized only a little more than ll% of this potential. Hydropower does not cause any pollution, it is Renewable and normally the hydro power projects are multi-purpose projects helping in controlling floods, used for irrigation, navigation etc. However, big dams are often associated with a number of Environmental impacts which have already been discussed in the previous section.

GEOTHERMAL ENERGY

The Energy harnessed from the hot rocks present inside the earth is called geothermal Energy. High temperature, high pressure steam fields exist below the earth's surface in many places. This heat comes from the fission of radioactive material naturally present in the rocks. In some places, the steam or the hot water comes out of the ground naturally through cracks in the form of natural geysers as in Manikaran, Kullu and Sohana, Haryana. Sometimes the steam or boiling water underneath the earth do not find any place to come out. We can artificially drill a hole up to the hot rocks and by putting a pipe in it make the steam or hot water gush out through the pipe at high pressure which turns the turbine of a generator to produce electricty. In USA and New Zealand, there are several geothermal plants working successfully.



BIOMASS ENERGY

Biomass is the organic matter produced by the plants or animals which include wood, crop residues, cattle dung, manure, sewage, agricultural wastes etc. Biomass Energy is of the following types :

(a) Energy Plantations: Solar Energy is trapped by green plants through photosynthesis and converted into biomass Energy. Fast growing trees like cottonwood, poplar and Leucaena, non-woody herbaceous grasses, crop plants like sugarcane, sweet sorghum and sugar beet aquatic weeds like water hyacinth and sea-weeds and carbohydrate rich potato, cereal etc. are some of the important Energy plantations. They may produce Energy either by burning directly or by getting converted into burnable gas or may be converted into fuels by fermentation.

(b) Petro-crops: Certain latex-containing plants like Euphorbias and oil palms are rich in hydrocarbons and can yield an oil like substance under high temperature and pressure. This oily material may be burned in diesel Engenes directly or may be refined to form gasoline. These plants are popularly known as petro-crops.

(c) Agricultural and Urban Waste biomass: Crop residues, bagasse (sugarcane residues), coconut shells, peanut hulls, cotton stalks etc. are some of the common agricultural wastes which produce Energy by burning. Animal dung, fishery and poultry waste and Even human refuse are examples of biomass Energy. In Brazil 30 % of electricity is obtained from burning biogases. In rural India, animal dung cakes are burnt to produce heat. About 80 % of rural heat Energy requirements are met by burning agricultural wastes, wood and animal dung cakes.

In rural areas these forms of waste biomass are burned in open furnaces called .Chulhas. which usually produce smoke and are not so efficient (efficiency is <8 %). Now improved Chulhas with tall chimney have been designed which have high efficiency and are smokeless. The burning of plant residues or animal wastes cause air pollution and produce a lot of ash as waste residue.

The turning of dung destroys essential nutrients like N and P. It is therefore, more useful to convert the biomass into biogas or bio-fuels.

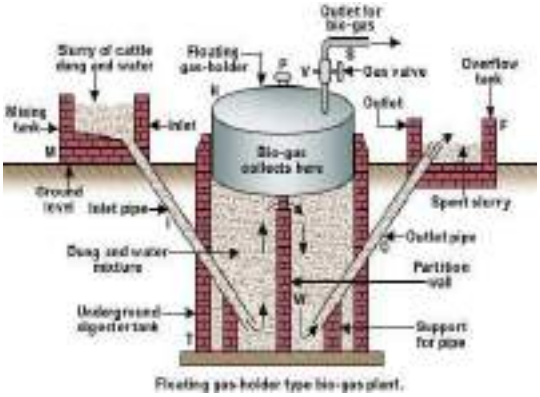
BIOGAS

Biogas is a mixture of methane, carbon dioxide, hydrogen and hydrogen sulphide, the major constituent being methane. Biogas is produced by anaerobic degradation of animal wastes (sometimes plant wastes) in the presence of water. Anaerobic degradation means break down of organic matter by bacteria in the absence of oxygen. Biogas is a non-polluting, clean and low cost fuel which is very useful for rural areas where a lot of animal waste and agricultural waste are available. India has the largest cattle population in the world (240 million) and has tremendous potential for biogas production. From cattle dung alone, we can produce biogas of a magnitude of 22,500 Mm3 annually. A sixty cubic feet gobar gas plant can serve the needs of one average family. Biogas has the following main advantages : It is clean, nonpolluting and cheap. There is direct supply of gas from the plant and there is no storage problem. The sludge left over is a rich fertilizer containing bacterial biomass with most of the nutrients preserved as such. Air-tight digestion/degradation of the animal wastes is safe as it eliminates health hazards which normally occur in case of direct use of dung due to direct exposure to fecal pathogens and parasites.

Biogas plants used in our country are basically of two types:

1. Floating gas-holder type
   And
2. Fixed-dome type.

I. Floating gas holder type biogas plant:

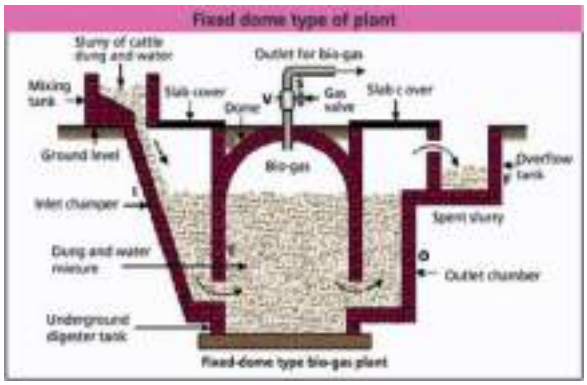


Floating gas-holder type bio-gas plant.

This type has a bell shaped digester tank which is placed under the ground and made up of bricks. In the digester tank, over the dung slurry an inverted steel drum floats to hold the bio-gas produced. The gas holder can over which is controlled by a pipe and the gas outlet is regulated by a valve. The digester tank has a partition wall and one side of it receives the dung water mixture through inlet pipe while the other side discharges the spent slurry through outlet pipe. Sometimes corrosion of steel gas-holder leads to leakage of biogas. The tank has to be painted time and again for maintenance which increases the cost. Hence another type was designed as discussed below :

2. Fixed dome type biogas plant:

The structure is almost similar to that of the previous type. However, instead of a steel gas-holder here is dome shaped roof made of cement and bricks. Instead of partitioning, here there is a single unit in the main digester but it has inlet and outlet chambers as shown



The Ministry of Non-Conventional Energy Sources (MNES) has been promoting the Biogas Programme in India. Out of the various models, the important ones used in rural set-up are KVIC Model(Floating drum type), Janta Model (Fixed dome type), Deenbandhu Model (Fixed dome type), Pragati Model (floating drum type), Ganesh Model (KVIC type but made of bamboo and polythene sheet) and Ferro-cement digester Model (KVIC type with ferro-cement digester)

.

BIOFUELS

Biomass can be fermented to alcohols like ethanol and methanol which can be used as fuels. Ethanol can be easily produced from carbohydrate rich substances like sugarcane. It burns clean and is non-polluting. However, as compared to petrol its calorific value is less and therefore, produces much less heat than petrol. Gasohol is a common fuel used in Brazil and Zimbabwe for running cars and buses. In India too gasohol is planned to be used on trial basis in some parts of the country, to start with in Kanpur. Gasohol is a mixture of ethanol and gasoline.

Methanol is very useful since it burns at a lower temperature than gasoline or diesel. Thus the bulky radiator may be substituted by sleek designs in our cars. Methanol too is a clean, non-polluting fuel. ethanol can be easily obtained from woody plants and ethanol from grain- ased or sugar-containing plants.

Hydrogen As A Fuel

As hydrogen burns in air, it combines with oxygen to form water and a large amount of Energy (l50 kilojoules per gram) is released. Due to its high, rather the highest calorific value, hydrogen can serve as an excellent fuel. Moreover, it is non-polluting and can be easily produced. Production of Hydrogen is possible by thermal dissociation, photolysis or electrolysis of water:

(i) By thermal dissociation of water (at 3000°K or above) hydrogen (H2) is produced.

(ii) Thermo chemically, hydrogen is produced by chemical reaction of water with some other chemicals in 2-3 cycles so that we do not need the high temperatures as in direct thermal method and ultimately H2 is produced.

(iii) Electrolytic method dissociates water into hydrogen (H2) and oxygen by making a current flow through it.

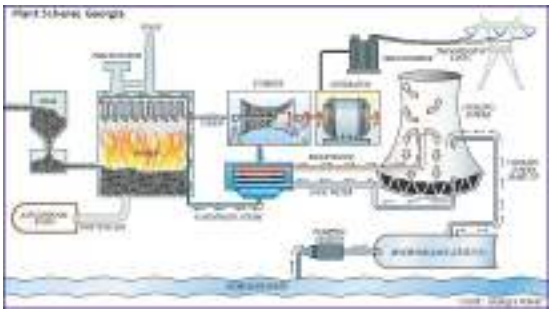
(iv) Photolysis of water involves breakdown of water in the presence of sun light to release hydrogen. Green plants also have photolysis of water during photosynthesis. Efforts are underway to trap hydrogen molecule which is produced during photosynthesis. However, hydrogen is highly inflammable and explosive in nature. Hence, safe handling is required for using H2 as a fuel. Also, it is difficult to store and transport. And, being very light, it would have to be stored in bulk. Presently, H2 is used in the form of liquid hydrogen as a fuel in spaceships.

(B). Non-Renewable Energy Sources

These are the fossil fuels like coal, petroleum, natural gas and nuclear fuels. These were formed by the decomposition of the remains of plants and animals buried under the earth millions of years ago. The fuels are very precious because they have taken such a long time to be formed and if we exhaust their reserves at such a fast rate as we have been doing, ever since we discovered them, then very soon we will lose these resources forever.

COAL

Coal was formed 255-350 million years ago in the hot, damp regions of the earth during the carboniferous age. The ancient plants along the banks of rivers and swamps were buried after death into the soil and due to the heat and pressure gradually got converted into peat and coal over millions of years of time. There are mainly three types of coal, namely anthracite (hard coal), bituminous (Soft coal) and lignite (brown coal). Anthracite coal has maximum carbon (90%) and calorific value (8700 kcal/kg.) Bituminous, lignite and peat contain 80, 70 and 60% carbon, respectively. Coal is the most abundant fossil fuel in the world. At the present rate of usage, the coal reserves are likely to last for about 200 years and if its use increases by 2% per year, then it will last for another 65 years. India has about 5% of world's coal and Indian coal is not very good in terms of heat capacity. Major coal fields in India are Raniganj, Jharia, Bokaro, Singrauli, and Godavari valley. The coal states of India are Jharkhand, Orissa, West BIngal, Madhya Pradesh, Andhra Pradesh and Maharashtra. Anthracite coal occurs only in J & K. When coal is burnt it produces carbon dioxide, which is a greenhouse gas responsible for causing Enhanced global warming. Coal also contains impurities like sulphur and therefore as it burns the smoke contains toxic gases like oxides of sulphur and nitrogen.



Coal based power plant

PETROLEUM

It is the lifeline of global economy. There are l3 countries in the world having 67% of the petroleum reserves which together form the OPEC (Organization of Petroleum exporting countries). About l/4th of the oil reserves are in Saudi Arabia. At the present rate of usage, the world's crude oil reserves are estimated to get exhausted in just 40 years. Some optimists, however, believe that there are some yet undiscovered reserves. Even then the crude oil reserves will last for another 40 years or so. Crude petroleum is a complex mixture of alkane hydrocarbons. Hence it has to be purified and refined by the process of fractional distillation, during which process different constituents separate out at different temperatures. We get a large variety of products from this, namely, petroleum gas, kerosene, petrol, diesel, fuel oil, lubricating oil, paraffin wax, asphalt, plastic etc. Petroleum is a cleaner fuel as compared to coal as it burns completely and leaves no residue. It is also easier to transport and use. That is the reason why petroleum is preferred amongst all the fossil fuels.

Liquefied petroleum gas (LPG): The main component of petroleum is butane, the other being propane and ethane. The petroleum gas is easily converted to liquid form under pressure as LPG. It is odourless, but the LPG in our domestic gas cylinders gives a foul smell. This is, in fact, due to ethyl mercaptan, a foul smelling gas, added to LPG so that any leakage of LPG from the cylinder can be detected instantaneously. Oil fields in India are located at Digboi (Assam), Gujarat Plains and Bombay High, offshore areas in deltaic coasts of Gadavari, Krishna, Kaveri and Mahanadi.

NATURAL GAS

It is mainly composed of methane (95%) with small amounts of propane and ethane. It is a fossil fuel. Natural gas deposits mostly accompany oil deposits because it has been formed by decomposing remains of dead animals and plants buried under the earth. Natural gas is the cleanest fossil fuel. It can be easily transported through pipelines. It has a high calorific value of about 50KJ/G and burns without any smoke. Currently, the amount of natural gas deposits in the world are of the order of 80,

450 g m.3. Russia has maximum reserves (40%), followed by Iran (l4%) and USA (7%). Natural gas reserves are found in association with all the oil fields in India. Some new gas fields have been found in Tripura, Jaisalmer, Off-shore area of Mumbai and the Krishna Godavari Delta.
Natural gas is used as a domestic and industrial fuel. It is used as a fuel in thermal power plants for generating electricity. It is used as a source of hydrogen gas in fertilizer industry and as a source of carbon in tyre industry.

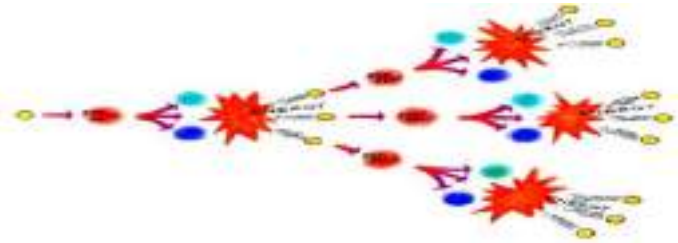
Compressed natural gas (CNG): It is being used as an alternative to petrol and diesel for transport of vehicles. Delhi has totally switched over to CNG where buses and auto rickshaws run on this new fuel. CNG use has greatly reduced vehicular pollution in the city.

Synthetic natural gas (SNG): It is a mixture of carbon monoxide and hydrogen. It is a connecting link between a fossil fuel and substituted natural gas. Low grade coal is initially transformed into synthetic gas by gasification followed by catalytic conversion to methane.

NUCLEAR ENERGY

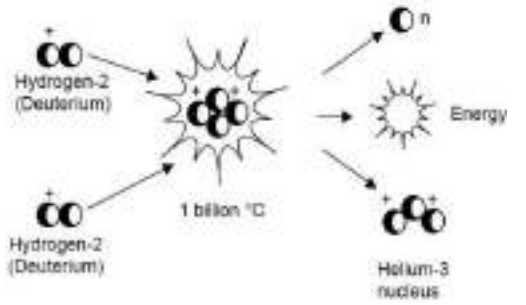
Nuclear Energy is known for its high destructive power as evidenced from nuclear weapons. The nuclear Energy can also be harnessed for providing commercial Energy. Nuclear Energy can be generated by two types of reactions:

Nuclear Fission:



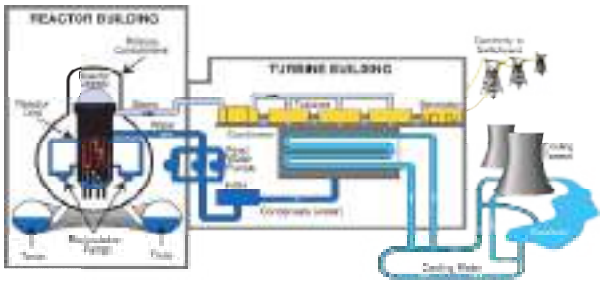
It is the nuclear change in which nucleus of certain isotopes with large mass numbers are split into lighter nuclei on bombardment by neutrons and a large amount of Energy is released through a chain reaction as shown..

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



$$_{1}H^{2} + {}_{1}H^{2} \longrightarrow {}_{3}He^{2} + {}_{0}n^{1} + \text{Energy}$$

Two hydrogen-2 (Deuterium) atoms may fuse to form the nucleus of Helium at l billion °C and release a huge amount of Energy. Nuclear fusion reaction can also take place between one Hydrogen-2 (Deuterium) and one Hydrogen-3 (Tritium) nucleus at l00 million °C forming Helium-4 nucleus, one neutron and a huge amount of Energy. Nuclear Energy has tremendous potential but any leakage from the reactor may cause devastating nuclear pollution. Disposal of the nuclear waste is also a big problem. Nuclear power in India is still not very well developed. There are four nuclear power stations with an installed capacity of 2005 MW. These are located at Tarapur (Maharashtra), Rana Pratap Sagar near Kota (Rajasthan), Kalpakkam (Tamil Nadu) and Narora (U.P.).



UNIT-3: Bio-Diversity and its Conservation

Bio-diversity.

Definition: variety and variability among the species of an community is called as bio-diversity.

Value Of Biodiversity

The value of biodiversity in terms of its commercial utility, ecological services, social and aesthetic value is Enormous. We get benefits from other organisms in innumerable ways. Sometimes we realize and appreciate the value of the organism only after it is lost from this earth. Very small, insignificant, useless looking organism may play a crucial role in the ecological balance of the ecosystem or may be a potential source of some invaluable drug for dreaded diseases like cancer or AIDS. The multiple uses of biodiversity or biodiversity value has been classified by McNeely et al in l990 as follows:

(i) Consumptive use value:

These are direct use values where the biodiversity product can be harvested and consumed directly e.g. fuel, food, drugs, fiber etc.

As Food: A large number of wild plants are consumed by human beings as food. About 80,000 edible plant species have been reported from wild. About 90% of present day food crops have been domesticated from wild tropical plants. Even now our agricultural scientists make use of the existing wild species of plants that are closely related to our crop plants for developing new hardy strains. Wild relatives usually possess better tolerance and hardiness. A large number of wild animals are also our sources of food.

Drugs and medicines: About 75% of the world's population depends upon plants or plant extracts for medicines. The wonder drug Penicillin used as an antibiotic is derived from a fungus called Penicillium. Likewise, we get Tetracycline from a bacterium. Quinine, the cure for malaria is obtained from the bark of Cinchona tree, while Digital in is obtained from foxglove (Digitalis) which is an effective cure for heart ailments. Recently vinblastin and vincristine, two anticancer drugs, have been obtained from Periwinkle (Catharanthus) plant, which possesses anticancer alkaloids. A large number of marine animals are supposed to possess anti-cancer properties which are yet to be explored systematically.

Fuel: Our forests have been used since ages for fuel wood. The fossil fuels coal, petroleum and natural gas are also products of fossilized biodiversity. Firewood collected by individuals are not normally marketed, but are directly consumed by tribal's and local villagers, hence falls under consumptive value.

(ii) Productive use values: These are the commercially usable values where the product is marketed and sold. It may include lumber or wild gene resources that can be traded for use by scientists for introducing desirable traits in the crops and domesticated animals. These may include the animal products like tusks of elephants, musk from musk deer, silk from silk-worm, wool from sheep, fir of many animals, lac from lac insects etc, all of which are traded in the market. Many industries are dependent upon the productive use values of biodiversity e.g.- the paper and pulp industry, Plywood industry, Railway sleeper industry, Silk industry, textile industry, ivory-works, leather industry, pearl industry etc. Despite international ban on trade in products from Endangered species, smuggling of fur, hide, horns, tusks, live specimen etc. worth millions of dollars are being sold every year. Developing countries in Asia, Africa and Latin America are the richest biodiversity centers and wild life products are smuggled and marketed in large quantities to some rich western countries and also to China and Hong Kong where export of cat skins and snake skins fetches a booming business.

(iii) Social Value: These are the values associated with the social life, customs, religion and psycho-spiritual aspects of the people. Many of the plants are considered holy and sacred in our country like Tulsi (holy basil), Peepal, Mango, Lotus, Bael

etc. The leaves, fruits or flowers of these plants are used in worship or the plant itself is worshipped. The tribal people are very closely linked with the wild life in the forests. Their social life, songs, dances and customs are closely woven around the wildlife. Many animals like Cow, Snake, Bull, Peacock, Owl etc. also have significant place in our psycho-spiritual arena and thus hold special social importance. Thus biodiversity has distinct social value, attached with different societies.

(iv) Ethical value: It is also sometimes known as existence value. It involves ethical issues like .all life must be preserved.. It is based on the concept of .Live and Let Live.. If we want our human race to survive, then we must protect all biodiversity, because biodiversity is valuable. The ethical value means that we may or may not use a species, but knowing the very fact that this species exists in nature gives us pleasure. We all feel sorry when we learn that passenger pigeon. Or dodo. is no more on this earth. We are not deriving anything direct from Kangaroo, Zebra or Giraffe, but we all strongly feel that these species should exist in nature. This means, there is an ethical value or existence value attached to each species.

(v) Aesthetic value: Great aesthetic value is attached to biodiversity. No one of us would like to visit vast stretches of barren lands with no signs of visible life. People from far and wide spend a lot of time and money to visit wilderness areas where they can Enjoy the aesthetic value of biodiversity and this type of tourism is now known as eco-tourism.The .Willingness to pay. concept on such eco-tourism gives us Even a monetary estimate for aesthetic value of biodiversity. Ecotourism is estimated to generate about l2 billion dollars of revenue annually, that roughly gives the aesthetic value of biodiversity.

(vi) Optional values: These values include the potentials of biodiversity that are presently unknown and need to be explored. There is a possibility that we may have some potential cure for AIDS or cancer existing Within the depths of a marine ecosystem, or a tropical rainforest. Thus option value is the value of knowing that there are biological resources existing on this biosphere that may one day prove to be an effective option for something important in the future. Thus, the option value of biodiversity suggests that any species may prove to be a miracle species someday. The biodiversity is like precious gifts of nature presented to us. We should not commit the folly of losing these gifts Even before unwrapping them. The option value also includes the values, in terms of the option to visit areas where a variety of flora and fauna, or specifically some Endemic, rare or Endangered species exist.

(vii) Ecosystem service value: Recently, a non-consumptive use value related to self maintenance of the ecosystem and various important ecosystem services has been recognized. It refers to the services provided by ecosystems like prevention of soil erosion, prevention of floods, maintenance of soil fertility, cycling of nutrients, fixation of nitrogen, cycling of water, their role as carbon sinks, pollutant absorption and reduction of the threat of global warming etc. Different categories of biodiversity value clearly indicate that ecosystem, species and genetic diversity all have Enormous potential and a decline in biodiversity will lead to huge economic, ecological and socio-cultural losses.

Threats to Bio-diversity.

Extinction or elimination of a species is a natural process of evolution. In the geologic period the earth has experienced mass extinctions. During evolution, species have died out and have been replaced by others. However, the rate of loss of species in geologic past has been a slow process, keeping in view the vast span of time going back to 444 million years. The process of extinction has become particularly fast in the recent years of human civilization. In this century, the human impact has been so severe that thousands of species and varieties are becoming extinct annually. One of the estimates by the noted ecologist, E.O. Wilson puts the figure of extinction at l0,000 species per year or 27 per day! This startling figure raises an alarm regarding the serious threat to biodiversity. Over the last l50 years the rate of extinction has escalated more dramatically. If the present trend continues we would lose l/3rd to 2/3rd of our current biodiversity by the middle of twenty first century. Let us consider some of the major causes and issues related to threats to biodiversity.

Loss Of Habitat

Destruction and loss of natural habitat is the single largest cause of biodiversity loss. Billions of hectares of forests and grasslands have been cleared over the past l0,000 years for conversion into agriculture lands, pastures, settlement areas or development projects. These natural forests and grasslands were the natural homes of thousands of species which perished due to loss of their natural habitat. Severe damage has been caused to wetlands thinking them to be useless ecosystems.The unique rich biodiversity of the wetlands, estuaries and mangroves are under the most serious threat today. The wetlands are destroyed due to draining, filling and pollution thereby causing huge biodiversity loss. Sometimes the loss of habitat is in installments so that the habitat is divided into small and scattered patches, a phenomenon known as habitat fragmentation. There are many wild life species such as bears and large cats that require large territories to subsist. They get badly threatened as they breed only in the interiors of the forests. Due to habitat fragmentation many song birds are vanishing. There has been a rapid disappearance of tropical forests in our country also, at a rate of about 0.6% per year. With the current rate of loss of forest habitat, it is estimated that 20-25% of the global flora would be lost Within a few years. Marine biodiversity is also under serious threat due to large scale destruction of the fragile breeding and feeding grounds of our oceanic fish and other species, as a result of human intervention.

Poaching

Illegal trade of wildlife products by killing prohibited Endangered animals i.e. poaching is another threat to wildlife. Despite international ban on trade in products from Endangered species, smuggling of wildlife items like furs, hides, horns, tusks, live specimens and herbal products worth millions of dollars per year continues. The developing nations in Asia, Latin America and Africa are the richest source of biodiversity and have Enormous wealth of wildlife. The rich countries in Europe and North America and some affluent countries in Asia like Japan, Taiwan and Hong Kong are the major importers of the wild life products or wild life itself.

The trading of such wild life products is highly profit making for the poachers who just hunt these prohibited wild life and smuggle it to other countries mediated through a mafia. The cost of elephant tusks can go upto $ l00 per kg; the leopard fur coat is sold at $ l00,000 in Japan while bird catchers can fetch upto $ l0,000 for a rare hyacinth macaw, a beautiful coloured bird, from Brazil. The worse part of the story is that for every live animal that actually gets into the market, about 50 additional animals are caught and killed. If you are fond of rare plants, fish or birds, please make sure that you are not going for the Endangered species or the wild-caught species. Doing so will help in checking further decline of these species. Also do not purchase fur coat, purse or bag, or items made of crocodile skin or python skin. You will certainly help in preserving biodiversity by doing so.

Man-Wildlife Conflicts

We have discussed about the need to preserve and protect our wildlife. However, sometimes we come across conflicting situations when wildlife starts causing immense damage and danger to man and under such conditions it becomes very difficult for the forest department to pacify the affected villagers and gain local support for wild-life conservation. Instances of man animal conflicts keep on coming to lime light from several states in our country. In Sambalpur, Orissa l95 humans were killed in the last 5 years by elephants. In retaliation the villagers killed 98 elephants and badly injured 30 elephants. Several instances of killing of elephants in the border regions of Kote-Chamarajanagar belt in Mysore have been reported Recently. The man-elephant conflict in this region has arisIn because of the massive damage done by the elephants to the farmer's cotton and sugarcane crops. The agonized villagers electrocute the elephants and sometimes hide explosives in the sugarcane fields, which explode as the elephants intrude into their fields. In fact, more killings are done by locals than by poachers. Recently, in early 2004, a man-eating tiger was reported to kill l6 Nepalese people and one 4-year old child inside the Royal Chitwan National Park, 240 Km South-west of Kathmandu. The Park renowned for its wildlife conservation effort has became a zone of terror for the locals. At times, such conflicting situations have been reported from the border regions of Corbett, Dudhwa, Palamau and Ranthambore National Parks in our country as well. Very Recently in June, 2004 two men were killed by leopards in Powai, Mumbai. A total of l4 persons were killed during l9 attacks since January by the leopards from the Sanjay Gandhi National Park, Mumbai which has created a panic among the local residents.

Causes of Man-animal conflicts: The root causes of these conflicts are discussed as:

(i) Dwindling habitats of tigers, elephants, rhinos and bears due to shrinking forest cover compels them to move outside the forest and attack the field or sometimes Even humans. Human Encroachment into the forest areas raises a conflict between man and the wildlife, perhaps because it is an issue of survival of both.

(ii) Usually the ill, weak and injured animals have a tendency to attack man. Also, the female tigress attacks the human if she feels that her newborn cubs are in danger. But the biggest problem is that if human-flesh is tasted once then the tiger does not eat any other animal. At the same time, it is very difficult to trace and cull the man-eating tiger and in the process many innocent tigers are also killed.

(iii) Earlier, forest departments used to cultivate paddy, sugarcane etc. Within the sanctuaries when the favorite staple food of elephants i.e. bamboo leaves were not available. Now due to lack of such practices the animals move out of the forest in search of food. It may be noted that, One adult elephant needs 2 quintals of green fodder and l50 kg of clean water daily and if it is not available, the animal strays out.
(iv) Very often the villagers put electric wiring around their ripe crop fields. The elephants get injured, suffer in pain and turn violent.
(v) Earlier there used to be wild-life corridors through which the wild animals used to migrate seasonally in groups to other areas. Due to development of human settlements in these corridors, the path of wildlife has been disrupted and the animals attack the settlements.
(vi) The cash compensation paid by the government in lieu of the damage caused to the farmers crop is not Enough. In Mysore, a farmer gets a compensation of Rs. 400/- per quintal of expected yield while the market price is Rs. 2400/- per quintal. The agonized farmer therefore gets revengeful and kills the wild animals.

Remedial Measures to Curb the Conflict

(i) Tiger Conservation Project (TCP) has made provisions for making available vehicles, tranquillizer guns, binoculars and radio sets etc. to tactfully deal with any imminent danger.

(ii) Adequate crop compensation and cattle compensation scheme must be started, along with substantial cash compensation for loss of human life.

(iii) Solar powered fencing should be provided along with electric current proof trenches to prevent the animals from straying into fields.

(iv) Cropping pattern should be changed near the forest borders and adequate fodder, fruit and water should be made available for the elephants Within forest zones.

(v) Wild life corridors should be provided for mass migration of big animals during unfavorable periods. About 300 km2 area is required for elephant corridors for their seasonal migration.
(vi) In Similipal Sanctuary, Orissa there is a ritual of wild animal hunting during the months of April-May for which forest is burnt to flush out the animals. Due to massive hunting by people, there is a decline in prey of tigers and they start coming out of the forest in search of prey. Now there is WWF-TCP initiative to curb this ritual of .Akhand Shikar. in Orissa.

ENDANGERED SPECIES OF INDIA

Definition: The Species which are very nearer to Extinct are called as Endangered species.
The International Union for Conservation of Nature and Natural Resources (IUCN) publishes the Red Data Book which includes the list of Endangered species of plants and animals. The red data symbolizes the warning signal for those species which are Endangered and if not protected are likely to become extinct in near future. In India, nearly 450 plant species have been identified in the categories of Endangered, threatened or rare. Existence of about l50 mammals and l50 species of birds is estimated to be threatened while an unknown number of species of insects are Endangered. It may not be of direct relevance here to give a complete list of Endangered flora and fauna of our country. However, a few species of Endangered reptiles, birds, mammals and plants are given below:

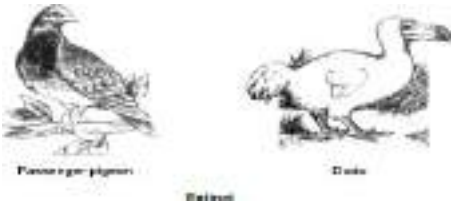
(a) **Reptiles :** Gharial, green sea turtle, tortoise, python
(b)**Birds:** Great Indian bustard, Peacock, Pelican,Great Indian Hornbill, Siberian WhiteCrane
(c) **Carnivorous :** Indian wolf, red fox, Sloth bear, red panda, Mammals tiger, leopard, striped hyIna, Indian lion,goldIn cat, desert cat, dugong
(d)**Primates:** Hoolock gibbon, lion-tailed macaque,Nilgiri langur, Capped monkey, goldIn monkey
(e)**Plants:** A large number of species of orchids,RhododIndrons, medicinal plants like Rauvolfia serpIntina, the sandal wood treeSantalum, Cycas beddonei etc.
The Zoological Survey of India reported that Cheetah, Pink headed duck and mountain quail have already become extinct from India.

A species is said to be extinct when it is not seen in the wild for 50 years at a stretch e.g. Dodo, passInger pigeon.

A species is said to be Endangered when its number has been reduced to a critical level or whose habitats, have been drastically reduced and if such a species is not protected and conserved, it is in immediate danger of extinction.

A species is said to be in vulnerable category if its population is facing continuous decline due to overexploitation or habitat destruction. Such a species is still abundant, but under a serious threat of becoming Endangered if causal factors are not checked.

Species which are not Endangered or vulnerable at present, but are at a risk are categorized as rare species. These taxa are usually localized Within restricted areas i.e. they are usually Endemic. Sometimes they are thinly scattered over a more extensive area. Some important Endangered and extinct species are shown in Plate IV.



ENDEMIC SPECIES OF INDIA

Definition: The Species which are live in a particular area are called as Endemic species.

India has two biodiversity hot spots and thus possesses a large number of Endemic species. Out of about 47,000 species of plants in our country 7000 are Endemic. Thus, Indian subcontinent has about 62% Endemic flora, restricted mainly to Himalayas, Khasi Hills and Western Ghats. Some of the important Endemic flora include orchids and species like Sapria himalayana, Uvaria lurida, NepInthes khasiana, Pedicularis perroter etc. Some Endemic plant species are shown in Plate V. A large number out of a total of 8l,000 species of animals in our country is Endemic. The western ghats are particularly rich in amphibians (frogs, toads etc.) and reptiles (lizards, crocodiles etc.). About 62% amphibians and 50% lizards are Endemic to Western Ghats. Different species of monitor lizards (Varanus), reticulated python and Indian Salamander and Viviparous toad Nectophhryne are some important Endemic species of our country.

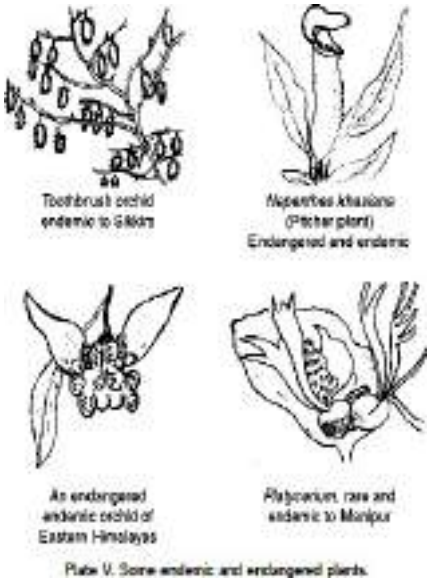


Plate V. Some endemic and endangered plants.

Bio-geographical classifications of India:

India's major biogeographic habitats

Sr. No.	Biogeographic Zone	Biotic Province	Total area (Sq. Km.)
1.	Trans-Himalayan	Upper Regions	186200
2.	Himalayan	North-West Himalayas West Himalayas Central Himalayas East Himalayas	6900 72000 123000 83000
3.	Desert	Kutch Thar Ladakh	45000 180000 NA
4.	Semi-Arid	Central India Gujarat-Rajwara	103600 40000
5.	Western Ghats	Malabar Coast Western Ghat Mountains	59300 99300
6.	Deccan Peninsula	Deccan Plateau South Central Plateau Eastern Plateau Chhota Nagpur Central Highlands	378000 341000 198000 217000 283000
7.	Gangetic Plain	Upper Gangetic Plain Lower Gangetic Plain	206400 153000

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India has different types of climate and topography in different parts of the country and these variations have induced Enormous variability in flora and fauna. India has a rich heritage of biological diversity and occupies the tenth position among

the plant rich nations of the world. It is very important to study the distribution, evolution, dispersal and Environmental relationship of plants and animals in time and space. Bio-geography comprising of phyto-geography and zoogeography deals with these aspects of plants and animals. In order to gain insight about the distribution and Environmental interactions of flora and fauna of our country, it has been classified into ten biogeographic zones. Each of these zones has its own characteristic climate, soil, topography and biodiversity.

Biological Diversity At National Level (Indian Biodiversity):

Every country is characterized by its own biodiversity depending mainly on its climate. India has a rich biological diversity of flora and fauna. Overall six percent of the global species are found in India. It is estimated that India ranks l0th among the plant rich countries of the world, llth in terms of number of Endemic species of higher vertebrates and 6th among the centers of diversity and origin of agricultural crops. The total number of living species identified in our country is l50,000. Out of a total of 25 biodiversity hot-spots in the world, India possesses two, one in the north-east region and one in the western Ghats. Indian is also one of the l2 mega-biodiversity countries in the world, which will be discussed later.

Regional Or Local Biodiversity

Biodiversity at regional level is better understood by categorizing species richness into four types, based upon their spatial distribution as discussed below

(i) Point richness refers to the number of species that can be found at a single point in a given space.

(ii) Alpha (α) richness refers to the number of species found in a small homogeneous area

(iii) Beta (β) richness refers to the rate of change in species composition across different habitats.

(iv) Gamma (γ) richness refers to the rate of change across large landscape gradients.

α -richness is strongly correlated with physical Environmental variables. For example, there are l00 species of tunicates in arctic waters, 400 species in temperate waters and 600 in tropical seas. Thus, temperature seems to be the most important factor affecting α –richness of tunicates.

β -richness means that the cumulative number of species increases as more heterogeneous habitats are taken into consideration. For example, the ant species found in local regions of north pole is merely l0. As we keep on moving towards the equator and thus add more and more habitats, the number of species of ants reaches as high as 2000 on the equatorial region.

India As A Mega-Diversity Nation

India is one of the l2 mega diversity countries in the world. The Ministry of Environment and Forests, Govt. of India (2000) records 47,000 species of plants and 8l,000 species of animals which is about 7% and 6.5% respectively of global flora and fauna. Distribution of species in some major groups of flora and fauna in India

Group-wise species Distribution			
Plants	**Number**	**Animals**	**Number**
Bacteria	850	Lower groups	9979
Fungi	23,000	Mollusca	5042
Algae	2500	Arthropoda	57,525
Bryophytes	2564	Pisces (Fishes)	2546
		Amphibia	
Pteridophytes	1022	Repriles	428
Gymnosperms	64	Birds	1228
Angiosperms	15,000		204
		Mammals	372

Endemism:

Species which are restricted only to a particular area are known as Endemic. India shows a good number of Endemic species. About 62% of amphibians and 50% of lizards are Endemic to India. Western Ghats are the site of maximum Endemism. Center of origin: A large number of species are known to have originated in India. Nearly 5000 species of flowering plants had their origin in India. From agro-diversity point of view also our country is quite rich. India has been the center of origin of l66 species of crop plants and 320 species of wild relatives of cultivated crops, thereby providing a broad spectrum of diversity of traits for our crop plants. Marine diversity: Along 7500 km long coastline of our country in the mangroves, estuaries, coral reefs, back waters etc. there exists a rich biodiversity. More than 340 species of corals of the world are found here. The marine diversity is rich in mollusks, crustaceans (crabs etc.) polychaetes and corals. Several species of Mangrove plants and sea grasses (Marine algae) are also found in our country.

A large proportion of the Indian Biodiversity is still unexplored. There are about 93 major wet lands, coral reefs and mangroves which need to be studied in detail. Indian forests cover 64.0l million hectares having a rich biodiversity of plants in the Trans-Himalayan, north-west, west, central and eastern Himalayan forests, western Ghats, coasts , deserts, Gangetic plains, Deccan plateau and the Andaman, Nicobar and Lakshadweep islands. Due to very diverse climatic conditions there is a complete rainbow spectrum of biodiversity in our country.

HOT SPOTS OF BIODIVERSITY

Areas which exhibit high species richness as well as high species Endemism are termed as hot spots of biodiversity. The term was introduced by Myers (l988). There are 25 such hot spots of biodiversity on a global level out of which two are present in India, namely the Eastern Himalayas and Western Ghats.

These hotspots covering less than 2% of the world's land area are found to have about 50% of the terrestrial biodiversity. According to Myers et al. (2000) an area is designated as a hotspot when it contains at least 0.5% of the plant species as Endemics. About 40% of terrestrial plants and 25% of vertebrate species are Endemic and found in these hotspots. After the tropical rain forests, the second highest number of Endemic plant species are found in the Mediterranean (Mittermeier). Broadly, these hot spots are in Western Amazon, Madagascar, North and East Borneo, North Eastern Australia, West Africa and Brazilian Atlantic forests. These are the areas of high diversity, Endemism and are also threatened by human activities. More than l billion people (about l/6th of the world's population) most of whom are desperately poor people, live in these areas. Any measures of protecting these hotspots need to be planned keeping in view the human settlements and tribal issues.

Earlier l2 hot spots were identified on a global level. Later Myers et al (2000) recognized 25 hot spots as shown in Table 4.3. Two of these hotspots lie in India extending into neighboring countries namely, Indo-Burma region (covering Eastern Himalayas) and Western Ghats - Sri Lanka region. The Indian hot spots are not only rich in floral wealth and Endemic species of plants but also reptiles, amphibians, swallow tailed butterflies and some mammals.

(a) Eastern Himalayas: They display an ultra-varied topography that fosters species diversity and Endemism. There are numerous deep and semi-isolated valleys in Sikkim which are extremely rich in Endemic plant species. In an area of 7298 Km2 of Sikkim about 4250 plant species are found of which 60% are Endemic. The forest cover of Eastern Himalayas has dwindled to about l/3rd of its original cover. Certain species like Sapria himalayana, a parasitic angiosperm was sighted only twice in this region in the last 70 years. Recent studies have shown that North East India along with its contiguous regions of Burma and Chinese provinces of Yunnan and Schezwan is an active center of organic evolution and is considered to be the cradle of flowering plants. Out of the world's recorded flora 30% are Endemic to India of which 35,000 are in the Himalayas.

(b) Western Ghats: It extends along a l7,000 Km2 strip of forests in Maharashtra, Karnataka, Tamil Nadu and Kerala and has 40% of the total Endemic plant species. 62% amphibians and 50% lizards are Endemic to Western Ghats. Forest tracts upto 500 m elevation covering 20% of the forest expanse are evergreen while those in 500-l500 m range are semi evergreen. The major centers of diversity are Agastyamalai Hills and Silent Valley. The New Amambalam Reserve Basin. It is reported that only 6.8% of the original forests are existing today while the rest has been deforested or degraded, which raises a serious cause of alarm, because it means we have already lost a huge proportion of the biodiversity.

Although the hotspots are characterized by Endemism, interestingly, a few species are common to both the hotspots in India. Some common plants include Ternstroemia japonica, Rhododendron and Hypericum, while the common fauna includes laughing thrush, Fairy blue bird, lizard hawk etc. indicating their common origin long back in the geological times.

Conservation Of Biodiversity

The Enormous value of biodiversity due to their genetic, commercial, medical, aesthetic, ecological and optional importance emphasizes the need to conserve biodiversity. Gradually we are coming to realize that wildlife is not just .a game to be hunted., rather it is a .gift of nature. To be nurtured and Enjoyed. A number of measures are now being taken the world over to conserve biodiversity including plants and wildlife.

There are two approaches of biodiversity conservation:

(a) In situ conservation (Within habitat): This is achieved by protection of wild flora and fauna in nature itself. e.g. Biosphere Reserves, National Parks, Sanctuaries, Reserve Forests etc.

(b) Ex situ conservation (outside habitats): This is done by establishment of gene banks, seed banks, zoos, botanical gardens, culture collections etc.

In Situ Conservation

At present we have 7 major Biosphere reserves, 80 National Parks, 420 wild-life sanctuaries and l20 Botanical gardens in our country covering 4% of the geographic area. The Biosphere Reserves conserve some representative ecosystems as a whole for long-term in situ conservation. In India we have Nanda Devi (U.P.), Nokrek (Meghalaya), Manas (Assam), Sunderbans (West BIngal), Gulf of Mannar (Tamil Nadu), Nilgiri (Karnataka, Kerala, Tamil Nadu), Great Nicobars and Similipal (Orrisa) biosphere Reserves. Within the Biosphere reserves we may have one or more National Parks. For example, Nilgiri Biosphere Reserve has two National Parks viz. Bandipur and Nagarhole National Park. A National Park is an area dedicated for the conservation of wildlife along with its Environment. It is also meant for Enjoyment through tourism but without impairing the Environment. Grazing of domestic animals, all private rights and forestry activities are prohibited Within a National Park. Each National Park usually aims at conservation specifically of some particular species of wildlife along with others. Some major National Parks of our country are Enlisted in the below:

Some important National parks in India

Name of National Park	State	Important Wildlife
Kaziranga	Assam	One horned Rhino
Gir National Park	Gujarat	Indian Lion
Dachigam	J & K	Hangul
Bandipur	Karnataka	Elephant
Periyar	Kerala	Elephant, Tiger
Kanha	M.P.	Tiger
Corbett	U.P.	Tiger
Dudwa	U.P.	Tiger
Ranthamboor	Rajasthan	Tiger
Sariska	Rajasthan	Tiger

Wildlife sanctuaries are also protected areas where killing, hunting, shooting or capturing of wildlife is prohibited except under the control of highest authority. However, private ownership rights are permissible and forestry operations are also permitted to an extent that they do not affect the wildlife adversely. Some major wildlife sanctuaries of our country are shown inform plants, there is one gene sanctuary for Citrus (Lemon family) and one for pitcher plant (an insect eating plant) in Northeast India. For the protection and conservation of certain animals, there have been specific projects in our country e.g. Project Tiger, Gir Lion Project, Crocodile Breeding Project, Project Elephant, Snow Leopard Project etc.

Some Important Wildlife Sanctuaries of India

Name of Sanctuary	State	Major Wild Life
Ghana Bird Sanctuary	Rajasthan	300 species of birds (including migratory)
Hazaribagh Sanctuary	Bihar	Tiger, Leopard
Sultanpur Bird Sanctuary	Haryana	Migratory birds
Nal Sarovar Bird Sanctuary	Gujarat	Water birds
Abohar Wildlife Sanctuary	Punjab	Black buck
Mudumalai Wildlife Sanctuary	Tamil Nadu	Tiger, elephant, Leopard
Vedanthangal Bird Sanctuary	Tamil Nadu	Water birds
Jaldapara Wild Life Sanctuary	W. Bengal	Rhinoceros, elephant, Tiger
Wild Ass Sanctuary	Gujarat	Wild ass, wolf, nilgai, chinkara

Ex situ Conservation:

This type of conservation is mainly done for conservation of crop varieties, the wild relatives of crops and all the local varieties with the main objective of conserving the total genetic variability of the crop species for future crop improvement or afforestation programmes. In India, we have the following important gene bank/seed bank facilities.

(i) National Bureau of Plant Genetic Resources (NBPGR) is located in New Delhi. Here agricultural and horticultural crops and their wild relatives are preserved by cryo-preservation of seeds, pollen etc. by using liquid nitrogen at a temperature as low as -l96°C. Varieties of rice, pearl millet, Brassica, turnip, radish, tomato, onion, carrot, chilli, tobacco, poppy etc. have been preserved successfully in liquid nitrogen for several years without losing seed viability.
(ii) National Bureau of Animal Genetic Resources (NBAGR)
located at Karnal, Haryana. It preserves the semen of domesticated bovine animals.

(iii) National Facility for Plant Tissue Culture Repository (NFPTCR) for the development of a facility of conservation of varieties of crop plants/trees by tissue culture. This facility has been created Within the NBPGR. The G-l5 countries have also resolved to set up a network of gene banks to facilitate the conservation of various varieties of aromatic and medicinal plants for which India is the networking coordinator country.

UNIT-4: Environmental Pollution.

Pollution:

Environmental pollution can be defined as any undesirable change in the physical, chemical or biological characteristics of any component of the Environment (air, water, soil), which can cause harmful effects on various forms of life or property. The substances polluting Environment are called pollutants.

Air Pollution:

It is an atmospheric condition in which certain substances (including the normal constituents in excess) are present in concentrations which can cause undesirable effects on man and his Environment. These substances include gases, particulate matter, radioactive substances etc. Gaseous pollutants include oxides of sulphur (mostly SO_2, SO_3) oxides of nitrogen (mostly NO and NO_2 or NO_x), carbon monoxide (CO), volatile organic compounds (mostly hydrocarbons) etc. Particulate pollutants include smoke, dust, soot, fumes, aerosols, liquid droplets, pollen grains etc.

Sources of Air Pollution:

The sources of air pollution are natural and man-made (anthropogenic).

Natural Sources: The natural sources of air pollution are volcanic eruptions, forest fires, sea salt sprays, biological decay, photochemical oxidation of terpenes, marshes, extra terrestrial bodies, pollen grains of flowers, spores etc. Radioactive minerals present in the earth crust are the sources of radioactivity in the atmosphere.

Man-made: Man-made sources include thermal power plants, industrial units, vehicular emissions, fossil fuel burning, agricultural activities etc. Thermal power plants have become the major sources for generating electricity in India as the nuclear power plants couldn't be installed as planned. The main pollutants emitted are fly ash and SO_2. Metallurgical plants also consume coal and produce similar pollutants. Fertilizer plants, smelters, textile mills, tanneries, refineries, chemical industries, paper and pulp mills are other sources of air pollution. Automobile exhaust is another major source of air pollution. Automobiles release gases such as carbon monoxide (about 77%), oxides of nitrogen (about 8%) and hydrocarbons (about l4%). Heavy duty diesel vehicles spew more NO_x and suspended particulate matter (SPM) than petrol vehicles which produce more carbon monoxide and hydrocarbons.

Effects of air pollution:

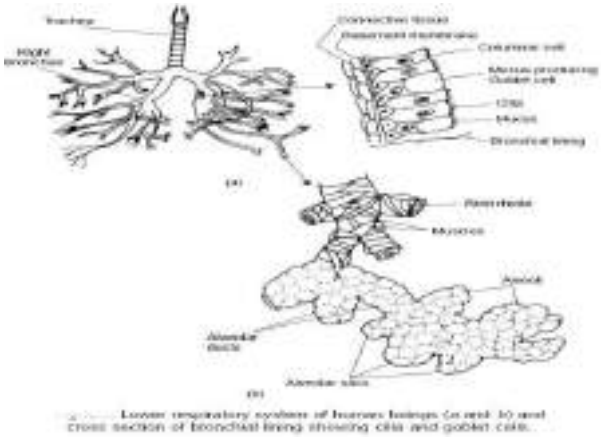
Air pollution has adverse effects on living organisms and materials.

Effect on Plants:

(i) SO2 causes chlorosis and also results in the death of cells and tissues.
(ii) Fluorides and PAN damage leafy vegetables such as lettuce and spinach.
(iii) Oxides of nitrogen and fluorides reduce crop yield.
(iv) Smog bleaches and blaze foliage of important leafy plants.
(v) Hydrocarbons cause premature yellowing, fall of leave and flower buds, discoloration and curling of sepals and petals.
(vi) Smoke and dust cover the leaf surface and reduce photosynthetic capacity of plants.
(vii) Ozone damages cereals, fruits, and cotton crop.

Effect on Man :

The effect of pollutants on animals and man are as follows-



(i) Ozone causes dryness of mucous membranes, changes eye vision, causes headache, pulmonary congestion and edema.
(ii) Ozone has been reported to produce chromosomal aberrations.
(iii) SO2 causes drying of mouth, scratchy throat, smarting eyes and disorders of respiratory tract.
(iv) SO3, CO and NO2 diffuse into blood stream and reduce oxygen transport. CO damages cardiovascular system. Hydrocarbons and other pollutants act, as carcinogens and lead to different cancers.
(v) Cotton dust leads to respiratory disorders e.g. bronchitis and asthma.
(vi) Smoking of tobacco causes cancerous growth in lungs.

Aesthetic Loss:

Dust and smoke spoils the beauty of nature. Especially the mountain Environments, which serve as a great attraction for tourists. Foul odours emitted by industries, automobiles, dirty drains and garbage heaps in cities are a great nuisance.

Control of Air Pollution

Air pollution can be minimized by the following methods:
Sitting of industries after proper Environmental Impact Assessment studies.
Using low sulphur coal in industries are Removing sulphur from coal (by washing or with the help of bacteria)
Removing NO_x during the combustion process.
Removing particulate from stack exhaust gases by employing electrostatic precipitators, bag-house filters, cyclone separators, scrubbers etc.
Vehicular pollution can be checked by regular tune-up of Engines; replacement of more polluting old vehicles; by engine modification to have fuel efficient (lean) mixtures to reduce CO and hydrocarbon emissions; and slow and cooler burning of fuels to reduce NO_x emission Using mass transport system, bicycles etc.
Shifting to less polluting fuels (hydrogen gas).

- Using non-conventional sources of Energy. Using biological filters and bio-scrubbers.
- Planting more trees

Water pollution:

Definition : Water pollution can be defined as alteration in physical, chemical or biological characteristics of water making it unsuitable for designated use in its natural state

Sources of Water Pollution:

(i) Domestic sewage :This includes household's wastes like food wastes, synthetic detergents used for washing clothes and cleaning bathrooms and latrines and water based paints.

(ii) Industrial effluents: The industrial wastes are discharged in the adjoining rivers and streams through flush lines of factories. The textiles, sugar and fertilizers factories, oil refineries, drugs manufacture, rubber, and rayon fibers, the paper industries and the chemical factories all produce Chemical pollution.

(iii) Agricultural source : Increased use of fertilizers has become essential for high yielding crop plants. Excess of nitrates used as fertilizers seep into ground water is carried into lakes and pond. On entering the drinking water supply system these create several health problems.

(iv) Pesticides : These include insecticides, fungicides, nematicides, rodenticides, herbicides and soil fumigants. These contain chlorinated hydrocarbons, organophosphates, metallic salts, carbonates, acetic acid derivatives etc. many pesticides are non-degradable. They pass through the food chains and accumulate in fatty tissues thus causing several health hazards.

(v) Thermal pollution Power plants and nuclear power stations: These are the main sources of thermal pollution of water where water is used for cooling and becomes hot. The hot water on entering the main water body raises its temperature, which kills fishes and other aquatic animals and increases the rate of respiration in aquatic plants.

(vi) Pathogenic organisms: Sewage and domestic waste from houses introduces pathogenic organisms viz., protozoa, worms-eggs and bacteria into water. This contaminated water if consumed causes jaundice, typhoid, dysentery, cholera, tuberculosis etc.

(vii) Mineral oils Oil from oil spills and washings of automobiles finds way into river water through sewers.

(viii) Underground water pollution Underground water particularly in cities and industrial areas is no more pure and safe. The sources of underground water pollution are sewage, seepage, pits, industrial effluents, septic tanks, fertilizers and pesticides, garbage etc.

(ix) Marine water pollution River and stream network sources of water ultimately end up ocean and seas. Thus, these acts as the sink of all natural and man-made water based pollutants. The main sources of oceanic pollution are discharges of oil, greases, petroleum products, detergents, sewage and garbage including radioactive wastes.

Effect of Water Pollutants:

The main effects of water pollutants are:
l. Compounds of mercury, arsenic and lead are poisonous and chemically harmful as they Even affect water treatment plants e.g. organic sulphur compounds interfere with nitrification.
2. Mercury when dissolved in water is absorbed by aquatic plants and enters the food chain. Lead impairs metabolism and brings about congenital deformities, anemia etc.
3. Cadmium damages kidneys and liver.
4. Inorganic nitrates and phosphates promote growth of oxygen-consuming algae, which result in the death of fishes and other aquatic animals.
5. Presence of dyes and compounds in the discharged water changes the colour of water.
6. Soap, detergents and, alkalis result in foam formation.
7. Industrial effluents containing iron, free chlorine, phenol, manganese, oils, hydrocarbons, ammonia, algae and microorganisms impair the taste and odours of water.
8. The nitrates and phosphates dissolved in water accelerate the growth of microorganisms, which consume much of the dissolved oxygen depriving fish and other aquatic life (Eutrophication).
9. Biomagnifications is the increase of toxic materials at each tropic level of a food chain.
For example, DDT after reaching a water system is absorbed by the microorganisms on which smaller fishes feed. From them, DDT reaches the carnivorous animals. Since bigger fishes consume more food, large amounts of DDT accumulates in their body.

Control Of Water Pollution :

(i) Separate ponds and tanks to be used for cattle and animals.
(ii) Use of pesticides, insecticides and fertilizers should be done judiciously. Rapid biodegradable substitutes for pesticides should be employed.
(iii) In towns where sewage facilities are not available, septic tanks should be made in the houses.
(iv) Rivers and lakes should not be used for bathing or washing as it contaminates water.

(v) Domestic sewage and industrial wastes should be treated before discharging them into drains.
(vi) Use of nitrogen fixing plants to supplement the use of fertilizers.
(vii) Adopting integrated pest management to reduce reliance on pesticides.
(viii) Prevent run-off of manure. Divert such run-off to basin for settlement. The Nutrient rich water can be used as fertilizer in the fields.

Proper chlorination should be done to prevent the formation of chlorinated hydrocarbons or disinfection should be done by ozone or ultraviolet radiations.

Soil pollution

Environmental pollution can be defined as any undesirable change in the physical, chemical or biological characteristics of any component of the Environment (air, water, soil), which can cause harmful effects on various forms of life or property. The substances polluting Environment are called pollutants.

Definition:

Like water and air, soil is also equally important for living organisms. It supports plants on which. all other living organisms depend. The process of soil formation is so slow that the soil may be regarded as a non-Renewable source. Any substance that reduces soil productivity is called soil pollutant.

Sources of Soil Pollution:

There are several materials, which adversely affect physical, chemical and biological properties of the soil and thus reduce its productivity. These are

l. Chemicals present in industrial waste.
2. Pesticides and insecticides that are sprayed on crops.
3. Fertilizers and manures that are added to the soil to increase the crop yield.

Effect of Soil Pollutants:

Chemicals and pesticides affect the structure and fertility of soil by killing the soil microorganisms. Pesticides are absorbed by the plants and then transferred to other organism. Hence, they affected food chains and food webs. Excretory products of livestock and human beings used as manure pollute the soil besides giving high yield. The faulty sanitation and unhygienic practices of the people add to the soil pollution. Pathogens present in the wastes and excreta contaminate the soil and vegetable crops causing diseases in man and domesticated animals.

Types of Soil Pollution:

It is of the following types-

(i) Positive soil pollution:

Reduction in the productivity of soil due to the addition of undesirable substances like pesticides, herbicides, fertilizers, etc. is called positive pollution. These pollutants have cumulative effect and kill the soil organisms.

(ii) Negative soil pollution:

It is caused by the removal of useful components from soil by erosion, deforestation and improper methods of agriculture.

Salination of Soil:

Increase in the concentration of soluble salts is called salination. This adversely affects the quality and productivity of soil. It takes place in two ways: accumulation of salts dissolved in irrigation water on the soil surface due to intensive farming and poor drainage, and deposition of salts as white crust during summer months drawn by capillary action from the lower surface to the top surface.

Control of Soil Pollution:

Various measure to control soil pollution are-

l. Transfer stations for bulk shifting of refuse should be constructed in cities and big towns.
2. Pneumatic pipes should be laid for collecting and disposing wastes.
3. Materials like paper, glass and plastics can be recycled.

4. Metals should be recovered from scrap and disposed materials.
5. Use of chemical fertilizers should be reduced by the use of bio fertilizers and manures.
6. Use of pesticides can be reduced by adopting biological control of pests.
7. Use of cattle dung and agricultural wastes in biogas plants should be Encourage d.
8. Deforestation can check soil erosion to a great extent.

Noise pollution:

We hear various types of sounds everyday. Sound is mechanical energy from a vibrating source. A type of sound may be pleasant to someone and at the same time unpleasant to others. The unpleasant and unwanted sound is called noise. Sound can propagate through a medium like air, liquid or solid.

Sound wave is a pressure perturbation in the medium through which sound travels. Sound pressure alternately causes compression and rarefaction. The number of compressions and rarefactions of the molecules of the medium (for example air) in a unit time is described as frequency. It is expressed in Hertz (Hz) and is equal to the number of cycles per second. There is a wide range of sound pressures, which Encounter human ear. Increase in sound pressure does not invoke linear response of human ear. A meaningful logarithmic scale has been devised. The noise measurements are expressed as Sound Pressure Level (SPL) which is logarithmic ratio of the sound pressure to a reference pressure. It is expressed as a dimensionless unit, decibel (dB). The international reference pressure of 2 × l0.5 Pa is the average threshold of hearing for a healthy ear. Decibel scale is a measure of loudness. Noise can affect human ear because of its loudness and frequency (pitch). The Central Pollution Control Board (CPCB) committee has recommended permissible noise levels for different locations as given in Sources of Noise Pollution The main sources of noise are various modes of transportation (like air, road, rail-transportation), industrial operations, construction activities and celebrations (social/religious functions, elections etc) electric home appliances. High levels of noise have been recorded in some of the cities of the world. In Nanjing (China) noise level of l05 dB has been recorded while in some other cities of the world these levels are: Rome 90 dB, New York 88 dB, Calcutta 85 dB, Mumbai 82 dB, Delhi 80 dB, Kathmandu 75 dB.

Effects of Noise pollution:

Noise causes the following effects.

(i) Interferes with man's communication: In a noisy area communication is severely affected.

(ii) Hearing damage: Noise can cause temporary or permanent hearing loss. It depends on intensity and duration of sound level. Auditory sensitivity is reduced with noise level of over 90 dB in the midnight frequency for more than a few minutes.

(iii) Physiological and Psychological changes: Continuous exposure to noise affects the functioning of various systems of the body. It may result in hypertension, insomnia (sleeplessness), gastro-intestinal and digestive disorders, peptic ulcers, blood pressure changes, behavioral changes, emotional changes etc.

Noise Pollution During Diwali

Diwali is a festival of lights. Traditionally people of all ages Enjoy firecrackers. Some accidents do occur every year claiming a few lives. Besides, noise generated by various firecrackers is beyond the permissible noise levels of l25 decibels as per the Environmental (Protection) (Second Amendment) Rules, l999. There has been a great concern over the noise levels generated during Diwali. Some measurements by certain group of researchers have also been made at various places during Diwali. It is recommended that the manufacturers of fireworks should mIntion the noise levels in decibels generated by individual items. The department of explosives of the Union Ministry of Commerce and Industry is Entrusted with the task to Insure that the industry produces firecrackers conforming to permissible noise standards. According to a recent test report on firecrackers produced by the National Physical Laboratory, New Delhi most of the firecrackers available in the market produce noise beyond the permissible levels of l25 decibels as per the Environment (Protection) (Second amendment) Rules, l999. Some of them have been observed to produce noise near the threshold of pain.

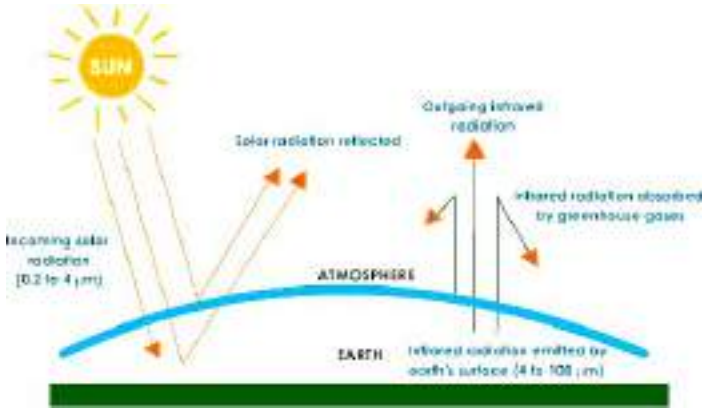
Environmental Problems in India

Green House gases effects and Global Worming.

Troposphere, the lowermost layer of the atmosphere, traps heat by a natural process due to the presence of certain gases. This effect is called Green House Effect as it is similar to the warming effect observed in the horticultural green house made of glass. The amount of heat trapped in the atmosphere depends mostly on the concentrations of .heat trapping. or .green house gases and the length of time they stay in the atmosphere. The major green house gases are carbon dioxide, ozone, methane, nitrous oxide, chlorofluorocarbons (CFCs) and water vapours.

The average global temperature is l5°C. In the absence of green house gases this temperature would have been .l8°C. Therefore, Green House Effect contributes a temperature rise to the tune of 33°C. Heat trapped by green house gases in the atmosphere keeps the planet warm Enough to allow us and other species to exist. The two predominant green house gases are water vapours, which are controlled by hydrological cycle, and carbon dioxide, which is controlled mostly by the global carbon cycle. While the levels of water vapour in the troposphere have relatively remained constant, the levels of carbon dioxide have increased. Other gases whose levels have increased due to human activities are methane, nitrous oxide and chlorofluorocarbons. Deforestation has further resulted in elevated levels of carbon dioxide due to non-removal of carbon dioxide by plants through photosynthesis.

Warming or cooling by more than 2°C over the past few decades may prove to be disastrous for various ecosystems on the earth including humans, as it would alter the conditions faster than some species could adapt or migrate. Some areas will become inhabitable because of drought or floods following a rise in average sea level.



Greenhouse Gases

The phenomenon that worries the Environmental scientists is that due to anthropogenic activities there is an increase in the concentration of the greenhouse gases in the air that absorb infra-red light containing heat and results in the re-radiation of Even more of the out going thermal infra-red Energy, thereby increasing the average surface temperature beyond l5°C. The phenomenon is referred to as the Enhanced green house effect to distinguish its effect from the one that has been operating naturally for millennia. The greenhouse gases present in the troposphere and resulting in an increase in the

Temperature of air and the earth are discussed here:

Carbon dioxide

It contributes about 55% to global warming from green house gases produced by human activity. Industrial countries account for about 76% of annual emissions. The main sources are fossil fuel burning (67%) and deforestation, other forms of land clearing and burning (33%). CO_2 stays in the atmosphere for about 500 years. CO_2 concentration in the atmosphere was 355 ppm in l990 that is increasing at a rate of l.5 ppm every year. Chlorofluorocarbons (CFCs).These are believed to be responsible for 24% of the human contribution to greenhouse gases. They also deplete ozone in the stratosphere. The main sources of CFCs include leaking air conditioners and refrigerators, evaporation of industrial solvents, production of plastic foams, aerosols, propellants etc. CFCs take l0-l5 years to reach the stratosphere and generally trap l500 to 7000 times more heat per molecule than CO_2 while they are in the troposphere. This heating effect in the troposphere may be partially offset by the cooling caused when CFCs deplete ozone during their 65 to ll0 years stay in the stratosphere. Atmospheric concentration of CFC is 0.00225 ppm that is increasing at a rate of 0.5% annually.

Methane (CH_4)

It accounts for l8% of the increased greenhouse gases. Methane is produced when bacteria break down dead organic matter in moist places that lack oxygen such as swamps, natural wetlands, paddy fields, landfills and digestive tracts of cattle, sheep and termites. Production and use of oil and natural gas and incomplete burning of organic material are also significant sources of methane. Methane stays in the atmosphere for 7-l0 years. Each methane molecule traps about 25 times as much heat as a CO_2 molecule. Atmospheric concentration of methane is l.675 ppm and it is increasing at a rate of l% annually Nitrous Oxide (N_2O) It is responsible for 6% of the human input of green house gases. Besides trapping heat in the troposphere it also depletes ozone in the stratosphere. It is released from nylon products, from burning of biomass and nitrogen rich fuels (especially coal) and from the breakdown of nitrogen fertilizers in soil, livestock wastes and nitrate contaminated ground water. Its life span in the

troposphere is l40-l90 years and it traps about 230 times as much heat per molecule as CO2. The atmospheric concentration of N_2O is 0.3 ppm and is increasing at a rate of 0.2% annually.

Impacts of Enhanced Greenhouse Effect:

The Enhanced greenhouse effect will not only cause global warming but will also affect various other climatic and natural processes.

(i) Global temperature increase: It is estimated that the earth's mean temperature will rise between l.5 to 5.5°C by 2050 if input of greenhouse gases continues to rise at the present rate. Even at the lower value, earth would be warmer than it has been for l0,000 years.

(ii) Rise in Sea Level: With the increase in global temperature sea water will expand. Heating will melt the polar ice sheets and glaciers resulting in further rise in sea level. Current models indicate that an increase in the average atmospheric temperature of 3°C would raise the average global sea level by 0.2.l.5 meters over the next 50.l00 years. One meter rise in sea level will inundate low lying areas of cities like Shanghai, Cairo, Bangkok, Sydney, Hamburg and Venice as well as agricultural lowlands and deltas in Egypt, Bangladesh, India, China and will affect rice productivity. This will also disturb many commercially important spawning grounds, and would probably increase the frequency of storm damage to lagoons, estuaries and coral reefs. In India, the Lakshadweep Islands with a maximum height of 4 meters above the level may be vulnerable. Some of the most beautiful cities like Mumbai may be saved by heavy investment on embankment to prevent inundation. Life of millions of people will be affected, by the sea level rise who have built homes in the deltas of the Ganges, the Nile, the Mekong, the Yangtze and the Mississippi rivers.

(iii) Effects on Human Health: The global warming will lead to changes in the rainfall pattern in many areas, thereby affecting the distribution of vector-borne diseases like malaria, filariasis, elephantiasis etc. Areas which are presently free from diseases like malaria, schistosomiasis etc. may become the breeding grounds for the vectors of such diseases. The areas likely to be affected in this manner are Ethiopia, Kenya and Indonesia. Warmer temperature and more water stagnation would favour the breeding of mosquitoes, snails and some insects, which are the vectors of such diseases. Higher temperature and humidity will increase/aggravate respiratory and skin diseases.

(iv) Effects on Agriculture: There are different views regarding the effect of global warming on agriculture. It may show positive or negative effects on various types of crops in different regions of the world. Tropical and subtropical regions will be more affected since the average temperature in these regions is already on the higher side. Even a rise of 2°C may be quite harmful to crops. Soil moisture will decrease and evapo-transpiration will increase, which may drastically affect wheat and maize production. Increase in temperature and humidity will increase pest growth like the growth of vectors for various diseases. Pests will adapt to such changes better than the crops. To cope up with the changing situation drought resistant, heat resistant and pest resistant varieties of crops have to be developed.

Measures to Check Global Warming to slow down Enhanced global warming the following steps will be important:

(i) Cut down the current rate of use of CFCs and fossil fuel.
(ii) Use Energy more efficiently.
(iii) Shift to Renewable Energy resources.
(iv) Increase Nuclear Power Plants for electricity production.
(v) Shift from coal to natural gas.
(vi) Trap and use methane as a fuel.
(vii) Reduce beef production.
(viii) Adopt sustainable agriculture.
(ix) Stabilize population growth.
(x) Efficiently remove CO_2 from smoke stacks.
(xi) Plant more trees.
(xii) Remove atmospheric CO_2 by utilizing photosynthetic algae.

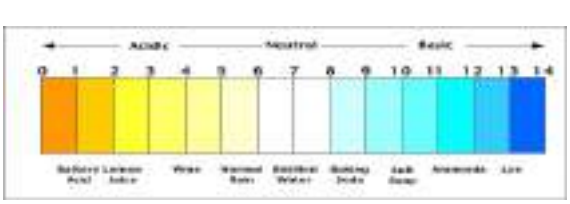
Acid Rains:

Oxides of sulfur and nitrogen originating from industrial operations and fossil fuel combustion are the major sources of acid forming gases. Acid forming gases are oxidized over several days by which time they travel several thousand kilometers. In the atmosphere these gases are ultimately converted into sulfuric and nitric acids. Hydrogen chloride emission forms hydrochloric acid. These acids cause acidic rain. Acid rain is only one component of acidic deposition. Acidic deposition is the total of wet

acidic deposition (acid rain) and dry deposition. Rain water is turned acidic when its pH falls below 5.6 .In fact clean or natural rain water has a pH of 5.6 at 20°C because of formation of carbonic acid due to dissolution of CO_2 in water. The Adirondack Lakes located in the state of New York are known to receive acid rains.

The strong acids like sulphuric acid (H_2SO_4) and nitric acid (HNO_3) dissolved or formed in rainwater dissociate or release hydrogen ions thereby increasing the acidity in rain drops. Generally sulfuric acid forms a major fraction of acid rain, followed by nitric acid and a very small fraction of other acids. However, in urban areas calcium (Ca_2^+), Magnesium (Mg_2^+) and ammonium (NH_4^+) ions help to neutralize the rain drops shifting the overall H^+ towards basic scale. The overall pH of any raindrop is due to the net effect of carbonic acid, sulfuric acid, nitric acid and other acidic constituents or any neutralizers such as ammonia. In the absence of rain, dry deposition of acid may occur. Acid forming gases like oxides of sulphur and nitrogen and acid aerosols get deposited on the surface of water bodies, vegetation, soil and other materials. On moist surfaces or in liquids these acid forming gases can dissolve and form acids similar to that formed in acid rain. If the oxidizers are present on the liquid surfaces then these gases undergo oxidation to form acids. Fine particles or acid droplets can act as nuclei for water to condense to form rain droplets. By such process sulfuric acid is incorporated into the droplets. In the clouds additional SO_2 and NO_2 contact the droplets and get absorbed which can be oxidized by the dissolved hydrogen peroxide (H_2O_2) or other oxidizers. In the droplets falling from the clouds additional acidic gases and aerosol particles get incorporated, further decreasing their pH. A unit decrease in pH value causes l0 times increase in acidity. Average pH in rainfall over eastern United States from April l979 to March l980 was less than 5.0. In India acid rain is recorded from certain places:

Name of place of rainwater	pH
Kodaikanal	5.l8
Minicoy	5.52
Mohanbari	5.50



Effects of acid rain

Acid rain causes a number of harmful effects below pH 5.l. The effects are visible in the aquatic system Even at pH less than l It causes deterioration of buildings especially made of marble e.g. monuments like Taj Mahal. Crystals of calcium and magnesium sulphate are formed as a result of corrosion caused by acid rain.
It damages stone statues. Priceless stone statues in Greece and Italy have been partially dissolved by acid rain. It damages metals and car finishes.

Aquatic life especially fish are badly affected by lake acidification. Aquatic animals suffer from toxicity of metals such as aluminium, mercury, manganese, zinc and lead which leak from the surrounding rocks due to acid rain.

It results in reproductive failure, and killing of fish. Many lakes of Sweden, Norway, Canada have become fishless due to acid rain.It damages foliage and weakens trees.

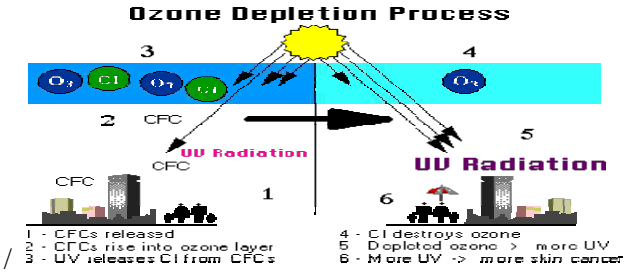
It makes trees more susceptible to stresses like cold temperature, drought, etc. Many insects and fungi are more tolerant to acidic conditions and hence they can attack the susceptible trees and cause diseases. Control of Acid Rain Emission of SO_2 and NO_2 from industries and power plants should be reduced by using pollution control equipments. Liming of lakes and soils should be done to correct the adverse effects of acid rain.

A coating of protective layer of inert polymer should be given in the interior of water pipes for drinking water.

OZONE LAYER DEPLETION:

For the last 450 million years the earth has had a natural sunscreen in the stratosphere called the ozone layer. This layer filters out harmful ultraviolet radiations from the sunlight and thus protects various life forms on the earth. Ozone is a form of oxygen. The molecule of oxygen contains two atoms whereas that of ozone contains three (O_3). In the stratosphere ozone is

continuously being created by the absorption of short wave- length ultraviolet (UV) radiations. Ultraviolet radiations less than 242 nanometers decompose molecular oxygen into atomic oxygen (O) by photolytic decomposition.



$$O_2 + h\upsilon \longrightarrow O + O$$

The atomic oxygen rapidly reacts with molecular oxygen to form ozone.

$$O + {}^{O}{}_{2} + M \longrightarrow {}^{O}{}_{3} + M$$

(M is a third body necessary to carry away the Energy released in the reaction). Ozone thus formed distributes itself in the stratosphere and absorbs harmful ultraviolet radiations (200 to 320 nm) and is continuously being converted back to molecular oxygen.

$$^{O}{}_{3} + h\upsilon \longrightarrow {}^{O}{}_{2} + O$$

Absorption of UV radiations results in heating of the stratosphere. The net result of the above reactions is an equilibrium concentration of ozone. Ozone concentration in about 24 km of the stratosphere i.e. from l6 km to 40 Km away from earth is about l0 ppm (as compared to 0.05 ppm concentration of harmful tropospheric ozone). This equilibrium is disturbed by reactive atoms of chlorine, bromine etc. which destroy ozone molecules and result is thinning of ozone layer generally called ozone hole. The amount of atmospheric ozone is measured by .Dobson Spectrometer. And is expressed in Dobson units (DU). One DU is equivalent to a 0.0l mm thickness of pure ozone at the density it would possess if it were brought to ground level pressure. Normally over temperate latitude its concentration is about 350 DU, over tropics it is 250 DU whereas at sub polar regions (except when ozone thinning occurs) it is on an average 450 DU. It is because of the stratospheric winds which transport ozone from tropical towards polar regions.

Thinning of Ozone Layer:

The Antarctic ozone hole was discovered by Dr Joe C. Farman and his colleagues in the British Antarctic Survey who had been recording ozone levels over this region since l957. During spring season of south pole i.e. September to November each year ozone depletion is observed. Steep decline has been observed since mid l970s with a record low concentration of 90 DU in early October of l993.

Chlorofluorocarbons (CFC) are mainly responsible for ozone depletion in the stratosphere. CFCs are a group of synthetic chemicals first discovered by Thomas Midgley Jr. in l930. CFC-ll and CFC-l2 are the CFCs most commonly used. CFCs are used as coolants in refrigerators and air conditioners, as propellants, cleaning solvents, sterilant and in styrofoam etc. CFCs released in the troposphere reach the stratosphere and remain there for 65-ll0 years destroying O_3 molecules. In l974, Rowland and Molina warned that CFC are lowering the concentration of ozone in the stratosphere and predicted severe consequences. It was however, in l985 that scientists for the first time discovered that 50% (98% in some areas) of upper stratospheric ozone over Antarctica was destroyed during the Antarctic spring and early summer (September-December). At Antarctic region the temperature during winter drops to . 90°C. The winds blowing in a circular pattern over earth.s poles create polar vortices. Water droplets in clouds when Inter these vortices form ice crystals. CFCs get collected on the surfaces of these ice crystals and destroy ozone much faster. Similar destruction of ozone over North Pole occurs during Arctic spring and early summer (February-June). The depletion is l0-25% and it is less than that observed at south pole.

Nitrous oxide emitted by supersonic aircrafts, during combustion of fossil fuel and use of nitrogen fertilizers breaks ozone molecules. Chlorine liberated from chlorofluorocarbons also break ozone molecules. The chain reaction started in Antarctic spring i.e. August/ September continues till nitrogen dioxide is liberated from nitric acid formed in the stratosphere by photolysis (breakdown by sunlight). Nitrogen dioxide combines with chlorine and stops further destruction of ozone.

Effects of Ozone Depletion l Ozone depletion in the stratosphere will result in more UV radiation reaching the earth especially UV-B (290-320 nm). The UV-B radiations affect DNA and the photosynthetic chemicals. Any change in DNA can result in

mutation and cancer. Cases of skin cancer (basal and squamous cell carcinoma) which do not cause death but cause disfigurement will increase.

Easy absorption of UV rays by the lens and cornea of eye will result in increase in incidents of cataract.

Melanin producing cells of the epidermis (important for human immune system) will be destroyed by UV-rays resulting in immune-suppression. Fair people (can't produce Enough melanin) will be at a greater risk of UV exposure.

Phytoplankton's are sensitive to UV exposure. Ozone depletion will result in decrease in their population thereby affecting the population of zooplankton, fish, marine animals, in fact the whole aquatic food chain.

Yield of vital crops like corn, rice, soybean, cotton, bean, pea, sorghum and wheat will decrease. Degradation of paints, plastics and other polymer material will result in economic loss due to effects of UV radiation resulting from ozone depletion.

UNIT-5 SOCIAL ISSUES AND THE ENVIRONMENT

Rain Water Harvesting System:

Rainwater harvesting is a technique of increasing the recharge of ground water by capturing and storing rainwater. Constructing special water harvesting structures like dug wells, percolation pits and lagoons, check dams etc does this. Whenever rain falls, it is captured and pollution of this water is prevented. Rainwater harvesting for poor and scanty rainfall regions but also for the rich ones.

Rainwater harvesting has the following objectives.

1. To reduce run off loss.
2. To avoid flooding of roads.
3. To meet the increasing demands of water.
4. To raise the water table by recharging ground water.
5. To reduce ground water contamination.
6. To supplement ground water supplies during lean season.

Rainwater can be mainly harvested by any one of the following methods.

l. By storing in tanks or reservoirs above or below ground.

2. By constructing pits, dug wells, lagoons, trench or check dams on small rivulets.

3. By recharging the ground water. Before adapting rainwater harvesting system, pattern and climatic conditions should be Studied

Traditional Rain Water harvesting:

In India, it is an old practice ¡n high rainfall areas to collect rainwater from roof —tops into storage tanks. In foot hills, water flowing from springs is collected by embankment type water storage. In Himalayan foothills people use the hollow bamboos as pipelines for the transport of the water. Rajasthan is known for its Tankas (underground tanks) and Khadins (embankmInts) for harvesting rainwater. In our ancient times we have adequate Talabs, Baawaris, Johars, Hauz etc in every city, village and capital cities of kings and lords, which were used to adequate water supply in dry periods.

Modern Techniques of Rain Water Harvesting :

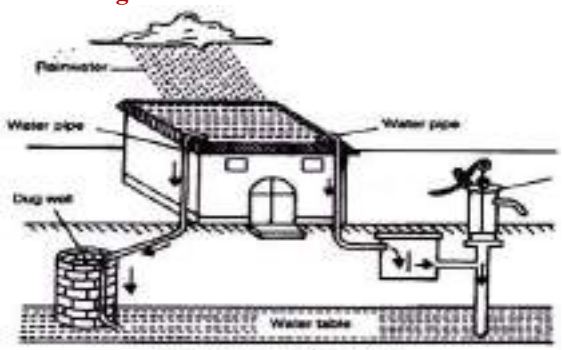


Fig. 15.3 Rainwater Harvesting

In arid and semi-arid regions shallow percolation tanks are constructed for artificial ground water recharging. Check- dams made of any suitable native material (Brush, poles, rocks, plants, loose rocks, wire-nets, stones, slabs, sacks etc) are constructed for harvesting run off from large

catchment areas. Rajendra Singh of Rajasthan popularly known as " water man" has been doing a commendable job for harvesting rain water by building check dams in Rajasthan and he was honored with the prestigious Magsaysay Award for his work

Ground water flow can be intercepted by building ground water dams for storing water in underground. As compared to surface dams, ground water dams have several, advantages like minimum evaporation loss, reduced chances of contamination etc.

In roof top rainwater harvesting, which ¡s a low cost and effective technique for urban houses and buildings, the rainwater from the top of the roof is diverted to some surface tank or pit through a delivery system, which can be later used for several purposes. Also, it can be used to recharge underground aquifers by diverting the stored water to some abandoned dug-well or by using a hand pump. All the above techniques of rainwater harvesting are low-cost methods with little maintenance cost. Rainwater harvesting helps in recharging the aquifers, improve ground water quality by dilution, improves soil moisture and reduce soil erosion by minimizing run-off water.

Watershed management:

The land area drained in a river is called river basin. The watershed is defined as the land area from which water drains under gravity to a common drainage channel. Thus, watershed is a delineated area with a well-defined topographic boundary and one water outlet. The water shed can be range from a few $(km)^2$ to few thousand $(km)^2$ in size. In the watershed the hydrological conditions are such that the water becomes concentrated Within a particular location like a river or a reservoir, by which the water shed is drained. The watershed comprises complex interactions of soil, landform, vegetation, land use activities and water. People and animals are an integral part of a watershed having mutual impacts on each other.

We may live anywhere, but here should be some watershed. A watershed is directly involved in sustained food production, water supply for irrigation, power generation, transportation as well as for influencing sedimentation and erosion, vegetation growth, floods and droughts. Thus, management of watersheds, treating them as a basic functional unit, important and the first such Integrated watershed Management was adopted in l949 by the Damodar valley corporation. Watershed management programmers were for the first time included in the fifth five year plan and have shown good results at sukhomajri and panchkula with the active participation of the local people.

Objectives of watershed management:

Rational utilization of land and water resources for optimum production with minimum damage to the natural resource is known as watershed management. The objectives of watershed management are as follows.

l. To rehabilitate the watershed through proper land use adopting conservation strategies for minimizing soil erosion and moisture retention so as to Insure good productivity of the land for the farmers'.

2. To manage the watershed for the beneficial developmental activities- like domestic water supply, irrigation and hydro power generation etc

3. To minimize the risks of floods, droughts and land slides

4. To develop rural areas in the region with clear plans for improving the economy of the region.

Watershed management practices:

In watershed management, the aspects of development are considered with regard to availability of resources. The practices of conservation and development of land and water are taken up with respect to their suitability for people's benefits as well as sustainability Various measures taken up for management include the following

l. Water harvesting

2. Afforestation and agroforestry

3. Mechanical measures for reducing soil erosion and run off losses
4. Scientific mining and quarrying
5. Public participation.

Watershed Management Practices

In the Fifth Five Year Plan, watershed management approach was included with a number of programmes for it and a national policy was developed. In watershed management, the aspects of development are considered with regard to the availability of resources. The practices of conservation and development of land and water are taken up with respect to their suitability for peoples. benefit as well as sustainability. Various measures taken up for management include the following:

(i) Water harvesting: Proper storage of water is done with provision for use in dry seasons in low rainfall areas. It also helpsin moderation of floods.

(ii) Afforestation and Agroforestry: In watershed development, afforestation and crop plantation play a very important role. They help to prevent soil erosion and retention of moisture. In high rainfall areas woody trees are grown in between crops to substantially reduce the runoff and loss of fertile soil. In Dehradun, trees like Eucalyptus and Leucaena and grasses like Chrysopogon are grown along with maize or wheat to achieve the above objectives. Woody trees grown successfully in such agroforestry programmes include Dalbergia sissoo (Sheesham), Tectona grandis (Teak) and Acacia nilotica (Keekar) which have been used in watershed areas of river Yamuna.

(iii) Mechanical measures for reducing soil erosion and runoff losses: Several mechanical measures like terracing, bunding, bench terracing, no-till farming, contour cropping, strip cropping etc. Are used to minimize runoff and soil erosion particularly on the slopes of watersheds. Bunding has proved to be a very useful method in reducing runoff, peak discharge and soil loss in Dehradun and Siwaliks.

(iv) Scientific mining and quarrying: Due to improper mining, the hills lose stability and get disturbed resulting in landslides, rapid erosion etc. Contour trenching at an interval of l meter on over burden dump, planting some soil binding plants like Ipomoea and Vitex and draining of water courses in the mined area are recommended for minimizing the destructive effects of mining in watershed areas.

(v) Public participation: People.s involvement including the farmers and tribals is the key to the success of any watershed management programme, particularly the soil and water conservation. People .s cooperation as well as participation has to be Insured for the same. The communities are to be motivated for protecting a freshly planted area and maintaining a water harvesting structure implemented by the government or some external agency (NGO) independently or by involving the local people. Properly educating the people about the campaign and its benefits or sometimes paying certain incentives to them can help in effective people's participation.

Successful watershed management has been done at Sukhomajri Panchkula, Haryana through active participation of the local people. Watershed management in Himalayan region is of vital importance since most of the watersheds of our country lie here. Several anthropogenic activities accelerate its slope instability which need to be prevented and efforts should be made to protect the watershed by preventing overgrazing, terracing and contour farming to check runoff and erosion etc. On steeper slopes with sliding faces, straw mulching tied with then wires and ropes helps in establishing the vegetation and stabilizing the slopes.

Water Scarcity:

Water ¡s indispensable for life and Environment. With the population explosion and modern life styles, pressure on water resources is increasing day by day. We are heading towards water crisis, as there is every likelihood that ¡t will become a scarce commodity; considered to be always available in abundance and free gift of nature. Currently, over a billion people in the world have less than 50 liters of water per day, an amount that is considered barely adequate. By 2025, 3.5 billion people will be living in water- stressed countries. It is not only surface water depletion, but also ¡n many countries like India, Pakistan and China, the ground water level is falling rapidly, at the rate of one to two meters per year. At the same time, in developed countries they are consuming four to fourteen times more water for the domestic purpose to the minimum requirement. Therefore, the debate over water IS a crucial one for most Countries rich or poor. It revolves not just around economics or Engineering, but also Encompasses issues such as Environmental sustainability and social costs.

One of the least visible trends that are shaping our future is a falling of water table. Although irrigation problems such as water logging, salting and silting, go back several thousand years, aquifer depletion is a new one, confined largely to the last half-century, when diesel and electric pumps made it possible to extract underground water at rates that exceed the natural recharge from rainfall and melting snow. According to Sandra Poste Of the Global Water Policy Project, over pumping of aquifers in China, India North Africa, Saudi Arabia and the U.S. exceed l60 billion tons of water per year The largest single deficit is in

India and China. As India's population has tripled since l950, water demand has climbed to be double. As a result, water tables are falling in much of the country and wells are running dry in thousands of villages. The international Water Management Institute, the world's premier water research body, estimates that aquifer depletion and the resulting cutbacks in irrigation water could drop India's grain harvest by up to one -fourth. In a country that is adding l8 million people a year and where more than half of the children are malnourished and under weight, a shrinking harvest could increase hunger related deaths, adding to the 6 million worldwide who die each year from hunger and malnutrition. Africa and West Asia are worst effected due to scarcity of water. Other pans of the world are also likely to be effected because of ever increasing population. According to the survey of UN, about 80 countries including India comprising about 40% of the population of the world are already under water stress. States like Rajasthan, Gujarat, M.P., Orissa and Andhra Pradesh in our country are already facing severe water shortage. Conflicts over sharing of river water between neighboring countries or different states have now become quite common because of non-availability of sufficient water. In India various examples of such conflicts are dispute over sharing of Kaveri river water between Karnataka and Tamilnadu, Sharing of Yamuna water between Haryana and Delhi; resistance from the people of Punjab for completion of SYL(Sutlej Yamuna Link) is a dispute between Punjab and haryana. Similarly a recent case of termination of water sharing treaty by the Punjab Government is responsible for rising of hues and cries by other states and the matter has been taken to the courts.

Ground Water depletion : The growth in population and the increased economic activities industry and agriculture have adverse effects on water bodies. Both the quantity and quality of water are effected. People require water for drinking and other domestic purposes. The Industry consumes lot of water. The irrigation needs are large and assure water supply. With water levels decreasing in the shallow wells and lakes, people look to ground water sources. The utilization of ground water for irrigation, industries and drinking continue to increase in the last 2 or 3 decades due to increased population and urbanization. The demand is so high that the finite resources of water are over utilized. As a result, the ground water levels are getting depleted at much faster rates than they can be regenerated. This is leading to drying up of dug wells as well as bore wells. Installing electric motor pump sets deepened wells and bore wells further add to the lowering of water table. The drying up of bore wells forced the farmers to commit suicides in Andhra Pradesh, Karnataka and Maharashtra.
Unsustainable exploitation of ground water is the most pressing problem in India today upsetting all our growth objectives. It ¡s suicidal to go for huge projects which stresses on surface irrigation and which do not promote the stabilization of ground water resources

There are other reasons for the decline of ground water :
l.The erratic and inadequate rainfall results in the reduction and shortage of water in surface reservoirs

2.The building construction activities are sealing the permeable soil zone, reducing the area for percolation of rainwater into subsurface and increase in surface run off.

Controversies on Major Dams:

Since independence various dams like Bhakra, Heerakud, Nagarjuna Sagar and Damodar have played very important role in the progress of the country. The reservoirs of water along these dams provide water for various purposes like irrigation and electricity, which are the backbone for the progress of India. These also control water and prevent the floods. Most of the dams reflect the vision of our late prime minister Pt Jawahar Lal Nehuru, who praised these dams as "The temples of Modern India". Various Environmentalists are not in favor of these dams as they submerge the land, cause water logging and displace the people of that area. Dense population areas are seriously affected. The rehabilitation of affected people is not adequate. Displaced people remain unsettled for considerably long time because of the indifferent attitude of various Governments towards such people. Many small dams in place of big dam may cause less damage to the Environment. This idea may not find favor because smaller dams cannot meet the requirements of irrigation, hydropower and drinking water supply. We need water through out the year for various purposes but rainy season lasts only for 2-3 months ¡n a year. Moreover approximately 80% is lost as runaway water. Much of the rainwater should be stored so that it may be used throughout the year and this is possible through the building of dams at appropriate places. We must understand the importance of big dams. There is a lot of controversy regarding Tehri and Narmada dams, but we are sure that ultimately these prove to be a boon to the residents of those areas as the Aswan dam is today a boon to the Egyptian economy though Environmentalists categorized it is an ecological disaster when it was constructed across the Nile in Egypt in l970.

Resettlement and Rehabilitation Issues Problems and Concerns :

Economic development raises the quality and standard of living of the people of a country. However, in the process of development, very often there is an over-exploitation of natural resources and degradation of the Environment. Besides this, quite often, the native people of the project site are directly affected. These native people are generally the poorest of the poor,

underprivileged tribal people. Various types of projects result in the displacement of the native people who undergo tremendous economic and psychological distress, as the socio-economic and ecological base of the local community is disturbed

Displacement Problems due to dams:-
The bigger river valley projects have one of the most serious socio-economic impacts due to large scale displacement of ancestral home and loss of their traditional profession or occupation. Displacement due to mining: Mining is another developmental displacement of the native people. activity, which causes mining operation and the native people are displaced. Some times displacement of local people is due to accidents occurring in mined areas like subsidence.

Displacement due to creation of National Parks:
When some forest area is covered under a National Park, it ¡s a welcome step for conservation of the Natural resources. However, it also has a social aspect associated with it, which is often neglected. A major portion of the forest is declared as core area, where the entry of local dwellers or tribal is prohibited. When these villagers are deprived of their ancestral right of access to the forests, they usually retaliate by starting destructive activities. There is a need to look into their problems and provide them some employment.

Rehabilitation Issues:
The United Nations Universal Declaration on Human Rights [Article 25(l)] has declared, " Right to housing is a basic right". In India, most of the displacements have resulted due to land acquisition Act, l984, which empowers it to serve notice to the people to vacate their lands if there is a need as per government planning. Provision of each compensation in lieu of the land vacated exists in section l6 of the Act. The major issues related to displacement and rehabilitation are as follows.

l. Tribal are usually the most affected amongst the displaced that are already poor. Displacement further increases their poverty due to loss of land, home, Jobs, food insecurity, loss of access to common property assets, increased morbidity and mortality and social isolation.

2. Break up of families is an important social issue arising due to displacement in which the women are the worst effected and they are not Even given cash/land compensation

3. The tribal are not familiar with market policies and trends. Even if they get cash compensation, they get alienated in the modern economic set-up

4. The land acquisition laws ignore the common ownership of property, which is an inhibit system amongst the tribal's. Thus the tribal's lose the communitarian basis cultural existence . They feel like fish out of water

5. Kinship systems, marriages, social and cultural functions, their folk songs, dance activities vanish with their displacement. Even when they are resettled, it is individual based resettlement, which totally ignore communal settlements

6. Loss of identity and loss of intimate link between the people and the Environment is one of the biggest losses. The age long indigenous knowledge, which has been inherited and experienced by them about the flora, fauna, their uses etc get lost

Rehabilitation Policy :
There is a need for comprehensive National Rehabilitation Policy. Different states are following different practices in this regard. There is a need to raise public awareness on these issues to bring the resettlement and rehabilitation plans on a human footing and to honor the human rights of the ousters. India is one of the countries in the world leading in big dam construction and in the last 50 years more than 20 million people are estimated to have been directly or indirectly affected by these dams. The Hirakund dam has displaced more than 20000 people residing in about 250 villages. The Bhakra Nangal Dam was constructed during l950's and till now it has not been possible to rehabilitate Even half of the displaced people. It is the case of Tehri Dam on the river Bhagirathi, construction of Dam was green signaled after three decades of long campaign against the project by the noted Environmental activist Sunder Lai Bahuguna. He is also the propagator of the "Chipko movement". The immediate impact of Tehri dam would be on the Tehri town in which l0000 people are living. While displacement is looming large number of people, rehabilitation has become a more burning issue.

E.I.A.: Environmental Impact Assessment
Environmental Impact Assessment (EIA) is a process of evaluating the likely Environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

UNEP defines Environmental Impact Assessment (EIA) as a tool used to identify the Environmental, social and economic impacts of a project prior to decision-making. It aims to predict Environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local Environment and present the predictions and options to decision-makers. By using EIA both Environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment /clean-up costs and impacts of laws and regulations.

Although legislation and practice vary around the world, the fundamental components of an EIA would necessarily involve the following stages:

a. Screening to determine which projects or developments require a full or partial impact Assessment study;
b. Scoping to identify which potential impacts are relevant to assess (based on legislative requirements, international conventions, expert knowledge and public involvement), to identify alternative solutions that avoid, mitigate or compensate adverse impacts on biodiversity (including the option of not proceeding with the development, finding alternative designs or sites which avoid the impacts, incorporating safeguards in the design of the project, or providing compensation for adverse impacts), and finally to derive terms of reference for the impact Assessment;
c. Assessment and evaluation of impacts and development of alternatives, to predict and identify the likely Environmental impacts of a proposed project or development, including the detailed elaboration of alternatives;
d. Reporting the Environmental Impact Statement (EIS) or EIA report, including an Environmental management plan (EMP), and a non-technical summary for the general audience.
e. Review of the Environmental Impact Statement (EIS), based on the terms of reference (scoping) and public (including authority) participation.
f. Decision-making on whether to approve the project or not, and under what conditions;
g. Monitoring, compliance, enforcement and Environmental auditing. Monitor whether the predicted impacts and proposed mitigation measures occur as defined in the EMP. Verify the compliance of proponent with the EMP, to Insure that unpredicted impacts or failed mitigation measures are identified and addressed in a timely fashion.

Economy and Environment

From Unsustainable To Sustainable Development:

Sustainable development is defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”This definition was given by the Norwegian Prime Minister, G.H. Brundtland , who was also the Director of World Health Organization (WHO).Today sustainable development has become a buzz word and hundreds of programmes have been initiated in the name of sustainable development. If you want to test whether or not a possible will achieve the goals of sustainability just try to find out the following .Does it protect our biodiversity ?Does it prevent soil erosion? Does it prevent slow down population growth? Does it increase forest cover? Does it cut off CFC, SO_X ,NO_X and co_2?Does it reduce waste generation and does it benefits to all? These are only a few parameters for achieveng sustainable growth.

Until now development has been human-oriented, that too mainly ,for a few rich nations. They have touched the greatest heights of scientists and technological development, but at what cost? The air we breathe, the water we drink and the food we eat have all been badly polluted. Our natural resources are just weaker due to over exploitation. If growth continues in the same way ,very soon we will be facing a “doom’s day” – as suggested by Meadows et al(l972) in their world famous academic report “The limits to growth” This is unsustainable development which will lead to a collapse of the inter related systems of this earth.

Although the fears about such unsustainable growth and development started in l970’s, yet a clear discussion on sustainable development emerged on an international level in l992, in the UN Conference on Environment and development(UNCED),popularly known as The earth summit held at Rio de Janeiro, Brazil. The Rio declaration aims at “a new and equitable global partnership through the creation of new levels of cooperation among states .....” out of its five significant agreements Agenda-2l a global programme of action on sustainable development in social , economic and political context for the 21st century.

These are the key aspects for sustainable development:

(a) **Inter-generational equity:** This emphasizes that we should minimize any adverse impacts on resources and Environment for future generations i.e., we should hand over a safe, healthy and resourceful Environment to our future generations. This can be possible only if we stop over-exploitation of resources, reduce waste discharge and emissions and maintain ecological balance.

(b) **Intra-generation equity:** This emphasis that the development processes should seek to minimize the wealth gaps Within and between nations. The human development report of united nations(200l) emphasizes that the benefits of technology should seek to achieve the goals of intra-generational equity. The3 technology should address the problems of the developing countries, producing droughts tolerant varieties for uncertain climates , vaccines for infectious diseases, clean fuels for domestic and industrial use. This type of technological development will support the economic growth of the poor countries and help in narrowing the wealth gap and lead to sustainability.

Measures for sustainable development: some of the important measures for sustainable developments are as follows:

Using appropriate technology is one which is locally adaptable. Eco-friendly resources and local labour. Indigenous technologies are more useful, cost-efficient and sustainable. Nature is often taken as a model, using the natural conditions of that region as its components. This component is known as 'design with nature". the technology should use less of resources and should produce minimum waste.

Reduce, Reuse, Recycle approach(3R's): The 3-r approach advocating minimization of resources use, using them again and again instead of passing it on the waste stream and recycling the materials goes a long way in achieving the goals of sustainability . It reduces pressure on our resources as well as reduce waste generations and pollution .

Promoting Environmental education and awareness: Making Environmental education the centre of all learning process will greatly help in changing the thinking and attitude of people towards our earth and the Environment. Introducing the subject right from the school stage will inculcate a feeling of belongingness to earth in the small children . 'Earth thinking' will gradually get incorporated in our thinking and action which will greatly help in the transforming our lifestyles to sustainable ones.

Resource utilization as per carrying capacity: Any system can sustain a limited number of organisms on a long term basis which is known as its carrying capacity. In case of human beings, the carrying capacity concept becomes all the more complex. It is because unlike other animals, human beings, not only need food to live , but need so many other things to maintain the quality of life. Sustainability of a system depends early upon the carrying capacity of the system. If the carrying capacity of a system is crossed (say, by the over of a resources), Environmental degradation starts and continues till it reaches a point of no return .

Carrying capacity has two basic components: Supporting capacity i.e., the capacity to regenerate Assimilative capacity i.e., the capacity to tolerate different stresses.

In order to attain sustainability it is very important to utilize the resources based upon the above two properties of the system. Consumption should not exceed regeneration and changes should not be allowed to occur beyond the tolerant capacity of the system.

The Indian context

India has still to go a long way in implementing the concept of sustainable development. We have to lay emphasis on framing a well planned strategy for our development activity while increasing our economic growth. We have tremendous natural diversity as well as a huge population which makes planning for sustainable growth all the more important and complex. The national council of Environmental and coordination (NCPC) set up in l972 was the focal agency in this regard . The Ministry

of Environment & forests, set up in l985 has formulated guidelines for various development activities keeping in view the sustainability principles.

Urban Problems Related To Energy

Cities are the main centers of economic growth, trade, education, innovations and employment. Until Recently , a big majority of human population lived in rural areas and their economic activities centered around agricultural, cattle rearing, fishing or some cottage industry. It was some 200 years ago, with the dawn of industrial era, the cities showed a rapid development. Now about 50percent of the world population lives in urban areas and there is increasing movement of rural folk to cities search of employment. The urban growth is so fast that it is becoming difficult to accommodate all the industrial, commercial and residential facilities within a limit municipal boundary. As a result, there is spreading of the cities into the sub-urban or rural areas too, a phenomenon known as urban sprawl.

In developing countries too urban growth is very fast and in most of the cases it is uncontrollable and unplanned growth. In contrast to the rural set-up the urban set up is densely populated, consumers a lot of Energy and materials and generates a lot of waste.

The Energy requirements of urban population are much higher than that of rural ones. This is because urban people have a higher standard of life and their life styles demands more Energy inputs in every sphere of life. The Energy demanding activities include:

(1) Residential and commercial lighting.
(2) Transportation means including automobiles and public transport for moving residence to work place.
(3) Modern life style using a large number of electrical gadgets in every day life.
(4) Industrial plants using a big proportions of Energy.
(5) A large amount of waste generation which has to be disposed off properly using Energy based techniques.
(6) Control and prevention of air and water pollution which need Energy dependent technologies.
Due to high pollution density and high Energy demanding activities, the urban problems related to Energy are much more magnified as compared to the rural population

Water Conservation

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

(1) Decreasing run-off losses : Huge Water-loss Occurs due to run-off most of the soils, which can be reduced by allowing most of the water to infiltrate into the soil this can be achieved by using contour cultivation terrace farming water spreading chemical treatment or improved water-storage

- **Contour cultivation :** On small furrows and ridges across the slopes trap rainwater and allows more times for in filtration. Terracing constructed on deep soils have large water-storage capacity. On gentle trapped run off is spread over large area for better infiltration
- **Conservation-bench terracing :** involves construction of a series of bench for catching the run off train
- Water spreading : is done by channeling or lagoon-leveling in channeling, the water-flow is controlled by a series of diversions with vertical intervals. In lagoon leveling, small depression are dug in the area so that there is temporary storage of water
- **Chemical wetting agents (Surfactants) :** increases the water intake rates when added to normal irrigated soils
- Surface crop residues, Tillage's ,mulch, animal residues etc. help in reducing run-off by allowing more time for water to penetrate into the land
- **Chemical conditioners:** like gypsum ($Caso_4.2H_2O$)when applied to sodic soils improve soil permeability and reduce run off. Another useful conditioner is HPAN (hydrolysed polyacrylonitrile)

Water-Storage structure: like farm ponds, dug-outs etc. built's by individual farmer can be useful measures for conserving water through reduction of runoff.

(2) **Reducing evaporation losses :** This is more relevant in humid regions. Horizontal barriers of asphalt placed below the soils surface increase water availability and increases crop yield by 35-40%.This is more effective on sandy soil but less effective on loamy sand soils. A co-polymer of strachand acrylonitrile called 'super sulphur has been reported to absorb water upto l400 times its weight. The chemical has been found to be useful for sandy soils

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

(4) **Reducing irrigation losses:**

- Use of lined or covered canals to reduce seepage
- Irrigation in early morning or late Evening to reduce evaporation losses.
- Sprinkling irrigation and drip irrigation to conserve water by 30-50%.
- Growing hybrid crop verities with less water requirements and tolerance to saline water help conserve water

(5) **Re-use of water:**

- Treated wastewater can be used for ferti-irrigation.
- Using grey water from washings, bath-tubs etc. for watering gardens, washing cars or paths help in saving fresh water

(6) **Preventing wastage of water :** This can be done in house holds commercials buildings and public places

- Closing taps when not in use
- Repairing any leakage from pipes
- Using small capacity flushing toils

(7) Increasing block pricing : The consumer has to pay penalty higher bill with higher use of water. This helps in economics use of water the consumers.

The Environment (Protection) Act, l986

The Act came into force on Nov. l9, l986, the birth anniversary of our Late Prime Minister Indira Gandhi, who was a pioneer of Environmental protection issues in our country. The Act extends to whole of India. Some terms related to Environment have been described as follows in the Act:

(i) Environment includes water, air and land and the inter-relationships that exists among and between them and human beings, all other living organisms and property.

(ii) Environmental pollution means the presence of any solid, liquid or gaseous substance present in such concentration, as may be, or tend to be, injurious to Environment.

(iii) Hazardous Substance means any substance or preparation which by its physico-chemical properties or handling is liable to cause harm to human beings, other living organisms, property or Environment. The Act has given powers to the Central Government to take measures to protect and improve Environment while the state governments coordinate the actions. The most important functions of Central Govt. under this Act include setting up of:

(a) The standards of quality of air, water or soil for various areas and purposes.
(b) The maximum permissible limits of concentration of various Environmental pollutants (including noise) for different areas.
(c) The procedures and safeguards for the handling of hazardous substances.
(d) The prohibition and restrictions on the handling of hazardous substances in different areas.
(e) The prohibition and restriction on the location of industries and to carry on process and operations in different areas.
(f) The procedures and safeguards for the prevention of accidents which may cause Environmental pollution and providing for remedial measures for such accidents. The power of entry and inspection, power to take sample etc. under this Act lies with the Central Government or any officer empowered by it.

For the purpose of protecting and improving the quality of the Environment and preventing and abating pollution, standards have been specified under Schedule I- IV of Environment (Protection) Rules, l986 for emission of gaseous pollutants and discharge of effluents/waste water from industries. These standards vary from industry to industry and also vary with the medium into which the effluent in discharged or the area of emission. For instance, the maximum permissible limits of B.O.D. (Biochemical Oxygen Demand) of the waste water is 30 ppm if it is discharged into inland waters, 350 ppm if discharged into a public sewer and l00 ppm, if discharged onto land or coastal region. Likewise, emission standards vary in residential, sensitive and industrial area. Naturally the standards for sensitive areas like hospitals are more stringent. It is the duty of the Pollution Control Board to check whether the industries are following the prescribed norms or not. Under the Environmental (Protection) Rules, l986 the State Pollution Control Boards have to follow the guidelines provided under Schedule VI, some of which are as follows:

(a) They have to advise the Industries for treating the waste water and gases with the best available technology to achieve the prescribed standards.
(b) The industries have to be Encourage d for recycling and reusing the wastes.
(c) They have to Encourage the industries for recovery of biogas, Energy and reusable materials.
(d) While permitting the discharge of effluents and emissions into the Environment, the State Boards have to take into account the assimilative capacity of the receiving water body.

(e) The Central and State Boards have to emphasize on the implementation of clean technologies by the industries in order to increase fuel efficiency and reduce the generation of Environmental pollutants. Under the Environment (Protection) Rules, l986 an amendment was made in l994 for Environmental Impact Assessment (EIA) of Various Development Projects. There are 29 types of projects listed under Schedule I of the rule which require clearance from the Central Government before establishing. Others require clearance from the State Pollution Control Board, when the proposed project or expansion activity is going to cause pollution load exceeding the existing levels. The project proponent has to provide EIA report, risk analysis report, NOC from State Pollution Control Board, Commitment regarding availability of water and electricity, Summary of project report/feasibility report, filled in a questionnaire for Environmental appraisal of the project and comprehensive rehabilitation plan, if more than l000 people are likely to be displaced due to the project.
Under the Environment (Protection) Act, l986 the Central Government
also made the Hazardous Wastes (Management and Handling) Rules, l989. Under these rules, it is the responsibility of the occupier to take all practical steps to ensure that such wastes are properly handled and disposed off without any adverse effects. There are l8 Hazardous Waste categories recognized under this rule and there are guidelines for their proper handling, storage, treatment, transport and disposal which should be strictly followed by the owner.
The Environment (Protection) Act, l986 has also made provision for Environmental Audit as a means of checking whether or not a company is complying with the Environmental laws and regulations. Thus, ample provisions have been made in our country through law for improving the quality of our Environment.

Water (Prevention And Control Of Pollution) Act, l974

It provides for maintaining and restoring the wholesomeness of water by preventing and controlling its pollution. Pollution is defined as such contamination of water, or such alteration of the physical, chemical or biological properties of water, or such discharge as is likely to cause a nuisance or render the water harmful or injurious to public health and safety or harmful for any other use or to aquatic plants and other organisms or animal life. The definition of water pollution has thus encompassed the Entire probable agents in water that may cause any harm or have a potential to harm any kind of life in any way. The salient features and provisions of the Act are summed up as follows:

(i) It provides for maintenance and restoration of quality of all types of surface and ground water.

(ii) It provides for the establishment of Central and State Boards for pollution control.

(iii) It confers them with powers and functions to control pollution. The Central and State Pollution Control Boards are widely represented and are given comprehensive powers to advise, coordinate and provide technical assistance for prevention and control of pollution of water.

(iv) The Act has provisions for funds, budgets, accounts and audit of the Central and State Pollution Control Boards.

(v) The Act makes provisions for various penalties for the defaulters and procedure for the same. The main regulatory bodies are the Pollution Control Boards, which have been, conferred the following duties and powers:

Central Pollution Control Board (CPCB):

It advises the central govt. in matters related to prevention and control of water pollution. Coordinates the activities of State Pollution Control Boards and provides them technical assistance and guidance. Organizes training programs for prevention and control of pollution.

Organizes comprehensive programs on pollution related issues through mass media. Collects, compiles and publishes technical and statistical data related to pollution.

Prepares manuals for treatment and disposal of sewage and trade effluents. Lays down standards for water quality parameters.

Plans nation-wide programs for prevention, control or abatement of pollution.

Establishes and recognizes laboratories for analysis of water, sewage or trade effluent sample. The State Pollution Control Boards also have similar functions to be executed at state level and are governed by the directions of CPCB.

The Board advises the state govt. with respect to the location of any industry that might pollute a stream or a well.

It lays down standards for effluents and is empowered to take samples from any stream, well or trade effluent or sewage passing through an industry.

The State Board is empowered to take legal samples of trade effluent in accordance with the procedure laid down in the Act. The sample taken in the presence of the occupier or his agent is divided into two parts, sealed, signed by both parties and sent or analysis to some recognized lab. If the samples do not conform to the prescribed water quality standards (crossing maximum permissible limits), then .consInt. is refused to the unit. Every industry has to obtain consent from the Board (granted for a fixed duration) by applying on a prescribed Performa providing all technical details, along with a prescribed fee following which analysis of the effluent is carried out. The Board suggests efficient methods for utilization, treatment and disposal of trade effluents.

The Act has made detailed provisions regarding the power of the Boards to obtain information, take trade samples, restrict new outlets, restrict expansion, Inter and inspect the units and sanction or refuse consent to the industry after effluent analysis. While development is necessary, it is all the more important to prevent pollution, which can jeopardize the lives of the people. Installation and proper functioning of effluent treatment plants (ETP) in all polluting industries is a must for checking pollution of water and land. Despite certain weaknesses in the Act, the Water Act has ample provisions for preventing and controlling water pollution through legal measures.

Forest (Conservation) Act, l980

This act deals with the conservation of forests and related aspects. Except J & K, the act is adopted all over India. The Act covers under it all types of forests including reserved forests, protected forests or any forested land irrespective of its ownership. The salient features of the Act are as follows:

(i) The State Govt. has been empowered under this Act to use the forests only for forestry purposes. If at all it wants to use it in any other way, it has to take prior approval of central Government, after which it can pass orders for declaring some part of reserve forest for non-forest purposes (e.g mining) or for clearing some naturally growing trees and replacing them by economically important trees (reforestation).

(ii) It makes provision for conservation of all types of forests and for this purpose there is an Advisory committee which recommends funding for it to the Central Government.

(iii) Any illegal non-forest activity Within a forest area can be immediately stopped under this Act. Non-forest activities include clearing of forest land for cultivation of any type of plants/crops or any other purpose (except re-afforestation). However, some construction work in the forest for wildlife or forest management is exempted from non-forest activity (e.g. fencing, making water-holes, trench, pipelines, check posts, wireless communication etc.)

l992 Amendment in the Forest Act

In l992, some amendment was made in the Act which made provisions for allowing some non-forest activities in forests, without cutting trees or limited cutting with prior approval of Central Govt. These activities are setting of transmission lines, seismic surveys, exploration, drilling and hydroelectric projects. The last activity involves large scale destruction of forest, for which prior approval of the Centre is necessary.

Wildlife sanctuaries, National Parks etc. are totally prohibited for any exploration or survey under this Act without prior approval of Central Govt. Even if no tree-felling is involved.

Cultivation of tea, coffee, spices, rubber and plants which are cash-crops, are included under non-forestry activity and not allowed in reserve forests.

Even cultivation of fruit-bearing trees, oil-yielding plants or plants of medicinal value in forest area need to be first approved by the Central Govt. This is because newly introduced species in the forest area may cause an imbalance in the ecology of the forest. If the species to be planted is a native species, then no prior clearance is required.

Tusser cultivation (a type of silk-yielding insect) in forest areas by tribal's as a means of their livelihood is treated as a forestry activity as long as it does not involve some specific host tree like Asan or Arjun. This is done in order to discourage monoculture practices in the forests which are otherwise rich in biodiversity.

Plantation of mulberry for rearing silkworm is considered a non-forest activity. The reason is same as described above.

Mining is a non-forestry activity and prior approval of Central Govt. is mandatory. The Supreme Court in a case T.N. Godavarman Thirumulkpad Vs. Union of India (l997) directed all on-going mining activity to be ceased immediately in any forest area of India if it had not got prior approval of Central government.

Removal of stones, bajri, boulder etc from river-beds located Within the forest area fall under non-forest activity.

Any proposal sent to central govt. for non-forest activity must have a cost-benefit analysis and Environmental Impact statement (EIS) of the proposed activity with reference to its ecological and socio-economic impacts. Thus, the Forests (Conservation) Act has made ample provisions for conservation and protection of forests and prevent deforestation.

Wildlife (Protection) Act, l972

The act, a landmark in the history of wildlife legislation in our country, came into existence in l972. Wildlife was transferred from State list to concurrent list in l976, thus giving power to the Central Govt. to enact the legislation.

The Indian Board of Wildlife (IBWL) was created in l952 in our country, which after the enactment of the Wildlife (Protection) Act actively took up the task of setting up wildlife National Parks and sanctuaries. The major activities and provisions in the act can be summed up as follows: (i) It defines the wild-life related terminology.

(ii) It provides for the appointment of wildlife advisory Board, Wildlife warden, their powers, duties etc. (iii) Under the Act, comprehensive listing of Endangered wild life species was done for the first time and prohibition of hunting of the Endangered species was mentioned.

(iv) Protection to some Endangered plants like Beddome cycad, Blue Vanda, Ladies Slipper Orchid, Pitcher plant etc. is also provided under the Act.

(v) The Act provides for setting up of National Parks, Wildlife Sanctuaries etc.

(vi) The Act provides for the constitution of Central Zoo Authority.

(vii) There is provision for trade and commerce in some wildlife species with license for sale, possession, transfer etc.

(viii) The Act imposes a ban on the trade or commerce in scheduled animals.
(ix) It provides for legal powers to officers and punishment to offenders.
(x) It provides for captive breeding programme for Endangered species. Several Conservation Projects for individual Endangered species like lion (l972) Tiger (l973), Crocodile (l974) and Brown antlered Deer (l98l) were started under this Act. The Act is adopted by all states in India except J & K, which has it own Act. Some of the major drawbacks of the Act include mild penalty to offenders, illegal wild life trade in J & K, personal ownership certificate for animal articles like tiger and leopard skins, no coverage of foreign Endangered wildlife, pitiable condition of wildlife in mobile zoos and little emphasis on protection of plant genetic resources.

The Air (Prevention And Control Of Pollution) Act, l98l

Salient features of the act are as follows:
(i) The Act provides for prevention, control and abatement of air pollution.

(ii) In the Act, air pollution has been defined as the presence of any solid, liquid or gaseous substance (including noise) in the atmosphere in such concentration as may be or tend to be harmful to human beings or any other living creatures or plants or property or Environment.

(iii) Noise pollution has been inserted as pollution in the Act in l987.

(iv) Pollution control boards at the central or state level have the regulatory authority to implement the Air Act. Just parallel to the functions related to Water (Prevention and Control of Pollution) Act, the boards performs similar functions related to improvement of air quality. The boards have to check whether or not the industry strictly follows the norms or standards laid down by the Board under section l7, regarding the discharge of emission of any air pollutant. Based upon analysis report consent is granted or refused to the industry.

(v) Just like the Water Act, the Air Act has provisions for defining the constitution, powers and function of Pollution Control Boards, funds, accounts, audit, penalties and procedures.

(vi) Section 20 of the Act has provision for ensuring emission standards from automobiles. Based upon it, the state govt. is empowered to issue instructions to the authority incharge of registration of motor vehicles (under Motor Vehicles Act, l939) that is bound to comply with such instructions.

(vii) As per Section l9, in consultation with the State Pollution Control Board, the state government may declare an area Within the state as .air pollution control area. and can prohibit the use of any fuel other than approved fuel in the area causing air pollution. No person shall, without prior consent of State Board operate or establish any industrial unit in the .air pollution control area. The Water and Air Acts have also made special provisions for appeals. Under Section 28 of Water Act and Section 3l of Air Act, a provision for appeals has been made. An Appellate Authority consisting of a single person or three persons appointed by the Head of the State, Governor is constituted to hear such appeals as filed by some aggrieved party (industry) due to some order made by the State Board Within 30 days of passing the orders. The Appellate Authority after giving the appellant and the State Board an opportunity of being heard, disposes off the appeal as expeditiously as possible.

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