COURSE: MSc Part -II

PAPER – XII

TOPIC- Environmental Biology

PREAPARED BY: Ajai Kishore Sharan

Topic-1

Sustainable development and its Strategy

The most widely used term ‘Sustainable Development’ was first coined by ‘Cocoyoc Dec-laration’ in 1970. Since then, the term has gained publicity and popularity. The word is now considered ‘panacea’ or medicine to combat all development-related problems—national or international.

This term ‘Sustainable Development’ went through threadbare discussions in different subsequent international summits like, IUCN Report (1980, 1990) and World Commission on Environment and Development (WECD) Report named ‘Our Common Future’ (1987). This famous Brunt-land Commission, named after the Norwegian Prime Minister Brunt-land, pre-pared a report—Our Common Future. Its prescribed sustainability as the only way out to wipe out the increasing danger visible on the future survival of mankind.

The Earth Summit at Rio de Janeiro (1992) reaffirmed its faith on Sustainable Develop-ment as the long-term strategy for human development. Not only international development reports, but individuals like Barbier (1987), Daly (1989), Pezzy (1989) and Rees (1988) also tried earnestly to develop the idea of sustainability of devel-opment.

Developing countries, like India, has to focus attention on the following measures:

1 ensure clean and hygienic living and working conditions for the people;

2 sponsor research on environmental issues pertaining to the region;

3 ensure safety against known and proven industrial hazards;

4. find economical methods for salvaging hazardous industrial wastes;

5. encourage afforestation;

6. find out substitutes for proven hazardous materials based on local resources and needs instead of blindly depending on advanced nations to find solutions;

7. ensuring environmental education as a part of school and college curriculum;

8. encourage use of non-conventional sources of energy, specially solar energy;

9. as far as possible, production of environment-friendly products should be encouraged;

10. use of organic fertilisers and other bio techniques should be popularised;

11. environmental management is the key for sustainable devel-opment, and it should include monitoring and accountability; and

12. Need for socialisation and also humanisation of all environ-mental issues.

The prime need for sustainable development is the conser-vation of natural resources. For conservation, the development policy should follow the following norms:

(i) Make all attempts not to impair the natural regenerative capacity of renewable resources and simultaneously avoid excessive pollution hampering the biospherical capacity of waste assimilation and life support system.

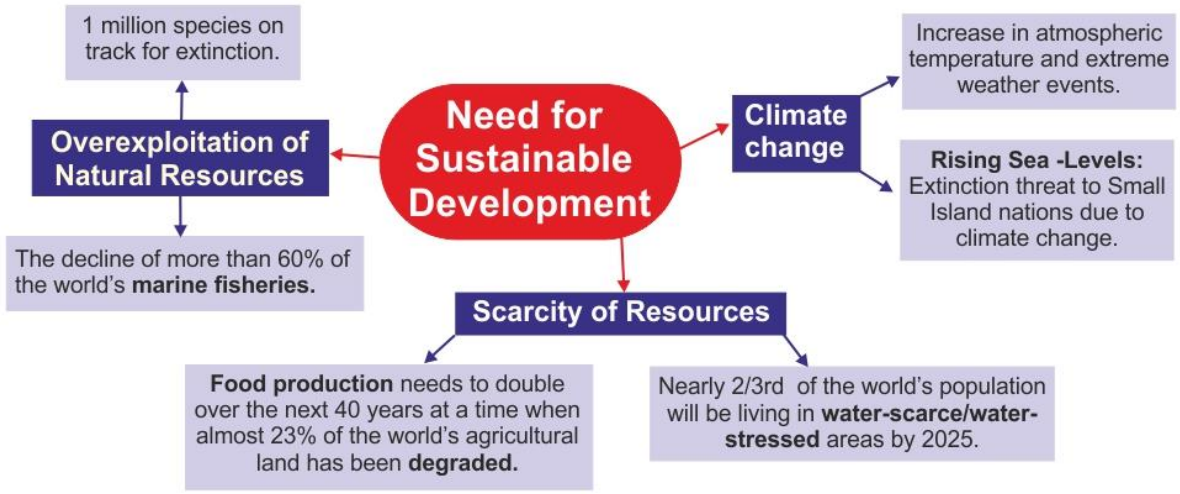
(ii) All technological changes and planning strategy processes, as far as physically possible, must attempt switch from non-renewable to renewable resource uses.

(iii) Formulate a phase-out policy for the use of non-renewable resources in general.

Thus, for a worldwide sustainable growth, there is need for efficient and effective management of available resources. In this field, the production of “environment-friendly products” (EFP) is a positive step. With the industrialisation and technological devel-opment, markets are flooded with products of daily consumption. They could however be a source of danger to health and damage to our environment.There is thus need to distinguish the more environmentally harmful consumer products from those which are less harmful, or have a more benign impact on the environment right from the stage of manufacture through packaging, distri-bution, use, disposal and reusability or recycling.

Throughout the world, emphasis is now being put on the production of EFP. In India, plans are afoot to market EFPs with combined efforts of Bureau of Indian Standards, Ministry of Environment and Forests and Central Pollution Control Board. Since 1990, a scheme of

labelling ECOMARK has also been started. In its first phase, the items included in this are soaps, plastics, papers, cosmetics, colours, lubricating oil, pesticides, drugs and various edible items.



The objectives of the scheme are:

(i) to provide an incentive for manufactures and to reduce adverse environmental impact of their products,
(ii) to reward genuine initiatives by companies to reduce adverse environmental impact of their products,
(iii) to assist consumers to become responsible in their daily lives by providing them information to take account of environmental factors in their purchase decisions,
(iv) to encourage citizens to purchase products which have less harmful environ-mental impact, and
(v) to improve the quality of the environment and to encourage the sustainable management of resources.

To cope with increased demand of the basic requirement of life and the limited supply of the natural resources, along with consid-eration of environmental degradation and ecological balance, we need to emphasise on optimal management of land, water, minerals and other natural resources. There is also need to utilize the native wisdom of those people, who live close to nature and earth, for eco-restoration along with development.

It is upon the decision-makers in politics to create the right framework and the pre-conditions for a sustainable development in agriculture. Global change is an ecological phenomenon, whereas globalisation is concerned with economic change. A recent analysis of sustainable agriculture in the context of trade liberalisation and globalisation raises equally significant

concern for a more informed decision-making process at local, regional and international levels.

The emerging issues related to the impact of globalisation on sustainable agriculture are as follows:

1. There are explicit problems with the conventional theoretical economic conditions for agricultural sustainability, especially when applied at the global level.

2. The processes of trade liberalisation and globalisation will not be uniform given the ecological and institutional diversity of the nations of the world.

3. There will be disparities in globalised impacts between rich and poor countries for agriculture, industries, sustainability and environment as well as income and poverty.

4. There is need for serious analysis of problems and policy initia-tives, since the risk of disruption to agricultural systems and environmental deterioration, social disruption and dislocation in the poorer countries of the world is clearly very high.

5. The type of production technology research, facilitated by private research, will not address the significant public good and externality issues facing developing countries.

6. There is need to focus on local farming situations as a basis of dealing with global problems, especially in poor countries.

7. There is need to understand local institutional situations so as to determine appropriate remedial economic policies based on institutional sustainability.

8. Integrated approach is essential for research and action at the regional scale related to water, atmosphere and climate, and species and ecosystems.

The pursuit of sustainability demands choices about the distri-bution of costs and benefits in space and time. There is also need to take advantage of the ‘traditional ecological knowledge’ (TEK), which encompasses all issues related to ecology and natural resource management, both at local and regional levels. Along with political dimensions of environment-society relations, the TEK can be used for both eco-restoration and sustainable development.

Topic-2

ECOSYSTEM

An ecosystem includes all of the living things (plants, animals and organisms) in a given area, interacting with each other, and also with their non-living environments (weather, earth, sun, soil, climate, atmosphere). Ecosystems are the foundations of the Biosphere and they determine the health of the entire earth system.

Structure and Function of an Ecosystem:

Each ecosystem has two main components:

(1) Abiotic- The non-living component

(2) Biotic- The living component

(1) Abiotic Components:

The non-living factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on the structure, distribution, behaviour and inter-relationship of organisms.

Abiotic components are mainly of two types:

(a) Climatic Factors: Which include rain, temperature, light, wind, humidity etc.

(b) Edaphic Factors: Which include soil, pH, topography minerals etc.?

The functions of important factors in abiotic components are given below:

Soils are much more complex than simple sediments. They contain a mixture of weathered rock fragments, highly altered soil mineral particles, organic mat-ter, and living organisms. Soils provide nutrients, water, a home, and a struc-tural growing medium for organisms. The vegetation found growing on top of a soil is closely linked to this component of an ecosystem through nutrient cycling.

The atmosphere provides organisms found within ecosystems with carbon di-oxide for photosynthesis and oxygen for respiration. The processes of evapora-tion, transpiration and precipitation cycle water between the atmosphere and the Earth’s surface.

Solar radiation is used in ecosystems to heat the atmosphere and to evapo-rate and transpire water into the atmosphere. Sunlight is also necessary for photosynthesis. Photosynthesis provides the energy for plant growth and me-tabolism, and the organic food for other forms of life.

Most living tissue is composed of a very high percentage of water, up to and even exceeding 90%. The protoplasm of a very few cells can survive if their water content drops below 10%, and most are killed if it is less than 30-50%.

Water is the medium by which mineral nutrients enter and are trans-located in plants. It is also necessary for the maintenance of leaf turgidity and is required for photosynthetic

chemical reactions. Plants and animals receive their water from the Earth's surface and soil. The original source of this water is precipita-tion from the atmosphere.

(2) Biotic Components:

The living organisms including plants, animals and micro-organisms (Bacteria and Fungi) that are present in an ecosystem form the biotic components.

On the basis of their role in the ecosystem the biotic components can be classi-fied into three main groups:

(A) Producers

(B) Consumers

(C) Decomposers or Reducers.

(A) Producers:

The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compounds namely water and carbon dioxide. This process is known as photo-synthesis. As the green plants manufacture their own food they are known as Autotrophs (i.e. auto = self, trophos = feeder)

The chemical energy stored by the producers is utilised partly by the producers for their own growth and survival and the remaining is stored in the plant parts for their future use.

(B) Consumers:

The animals lack chlorophyll and are unable to synthesise their own food. There-fore, they depend on the producers for their food. They are known as heterotrophs (i.e. heteros = other, trophos = feeder).

The consumers are of four types, namely:

(a) Primary Consumers or First Order Consumers or Herbivores: These are the animals which feed on plants or the producers. They are called her-bivores. Examples are rabbit, deer, goat, cattle etc.

(b) Secondary Consumers or Second Order Consumers or Primary Carnivores:

The animals which feed on the herbivores are called the pri-mary carnivores. Examples are cats, foxes, snakes etc.

(c) Tertiary Consumers or Third Order Consumers:

These are the large carnivores which feed on the secondary consumers. Example are Wolves.

(d) Quaternary Consumers or Fourth Order Consumers or Omnivores:

These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are lions and tigers.

(C) Decomposers or Reducers:

Bacteria and fungi belong to this category. They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food and re-lease to the environment the simple inorganic and organic substances produced as by-products of their metabolisms.

These simple substances are reused by the producers resulting in a cyclic ex-change of materials between the biotic community and the abiotic environment of the ecosystem. The decomposers are known as Saprotrophs (i.e., sapros = rotten, trophos = feeder)

Types of Freshwater Ecosystems

Freshwater ecosystems fall under the umbrella of aquatic biomes. As the name suggests, these ecosystems exclude oceans and saltwater lakes, swamps and marshes.

Some of the most common types of freshwater ecosystems are:

Lakes, Ponds, Streams, Freshwater wetlands

Freshwater ecosystems are the rarest type of ecosystem on Earth, only amounting to 0.8 percent of the Earth's surface and 0.009 percent of the water on Earth (the rest being saltwater).

Not all freshwater ecosystems are going to have the exact same biotic factors, as the organisms within those ecosystems will depend on many of the abiotic factors within the ecosystem that are determined mostly by climate and geographical location.

Biotic Factors in Freshwater Biomes:

Algae are the main autotrophs of fresh water biomes that perform photosynthesis. They're also sometimes called phytoplankton. Green algae, red algae and diatoms are all common types of photosynthetic algae that are found in freshwater ecosystems.

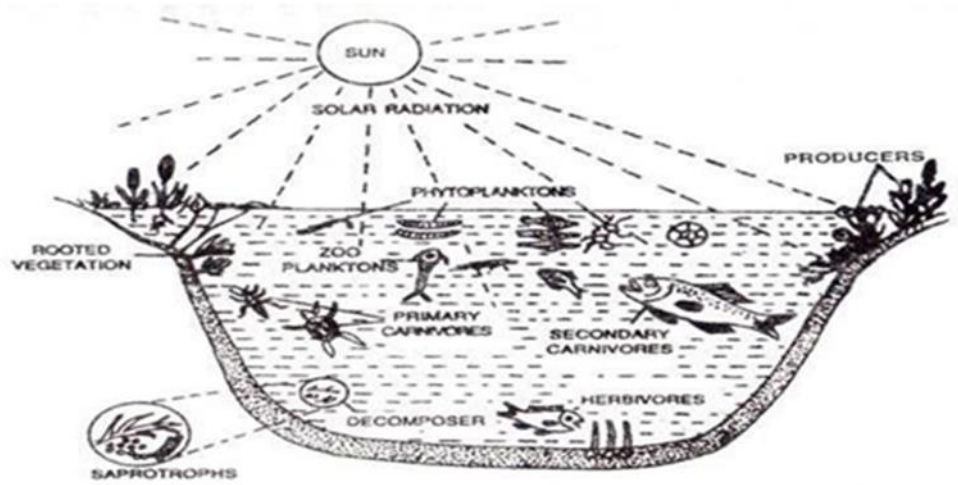
Invertebrates

Invertebrates are often the next trophic level up on the food chain after algae and other autotrophs.

In freshwater ecosystems, many invertebrates are primary consumers, which means they eat algae and other producers for food. They may also eat other invertebrates and small organisms in the water as well.

Common invertebrates in freshwater ecosystems include arthropods, worms, molluscs, other crustaceans, insects and more. Specific examples include: Earthworms, Dragonflies, Water mites, Leeches, Water fleas, Crayfish, Crabs, Fish

Some other species living in Fresh water biomes are Frogs and toads, Aquatic birds, Terrestrial birds that feed on fish/organisms in the freshwater Alligators and crocodiles, Water snakes, Turtles



Various trophic level of a Pond Ecosystem

Forest Ecosystem:

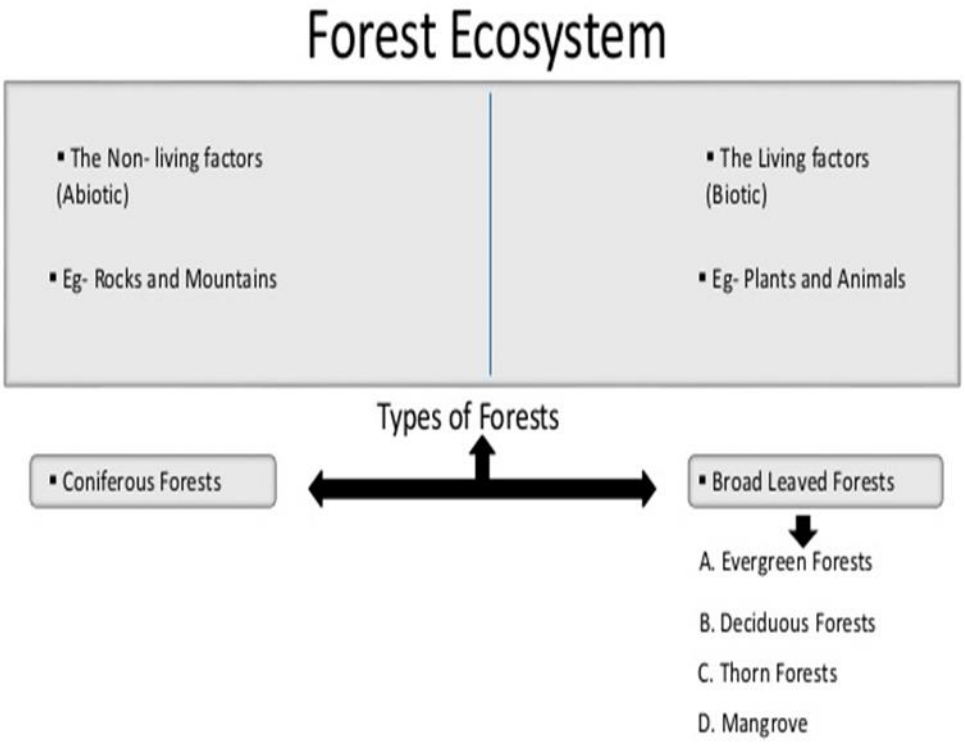
This also consists of:

The Producers; The trees, shrubs and moss are all producers. They turn water and sunlight into the energy they need to live and grow, through a process called photosynthesis.

The Primary consumers: The primary consumers are the large herbivores like deer as well as insects, rabbits and rodents. These creatures eat mostly plants, seeds, berries and grasses.

The Secondary consumers: Secondary consumers are the carnivorous animals that eat only herbivores.

Decomposers: Examples of decomposers include bacteria, fungi, some insects, and snails, which means they are not always microscopic. Fungi, such as the Winter Fungus, eat dead tree trunks. Decomposers can break down dead things, but they can also feast on decaying flesh while it's still on a living organism.



Grass land Ecosystem

Grassland Ecosystem is an area where the vegetation is dominated by grasses and other herbaceous (non-woody) plants. It is also called transitional landscape because grassland ecosystems are dominated by the grass with few or no trees in the area where there is not enough for a forest and too much of a forest.

Components of Grassland Ecosystem

The components of the Grassland Ecosystem are discussed below:

1. Abiotic Components: These are non-living thing components consist of carbon, hydrogen, sulphur, nitrogen and phosphorous etc.

2. Biotic Components: These are living components and its sub-components are discussed below-

(I) Producers: The primary producers of food are the grasses such as Aristida, Cynodon, Digitaria, Desmodium, Setaria etc. If herbs and shrubs are present, they also contribute to the primary production of food.

(II) Consumers: The consumers in a grassland ecosystem are of three levels.

(a) Primary consumers: These feed directly from the grasses (grazing) and include herbivores such as Cows, Buffaloes, Goats, Rabbits, Mouse etc. and also insects, termites, centipede, millipedes etc.

(b) Secondary consumers: These consumers are the carnivorous animals such as snakes, lizard, jackal, foxes, frogs etc. which feed on the primary consumers.

(c) Tertiary consumers: Hawk, Eagles and vultures constitute the tertiary consumer in the grassland ecosystem which preys upon the secondary and primary consumer.

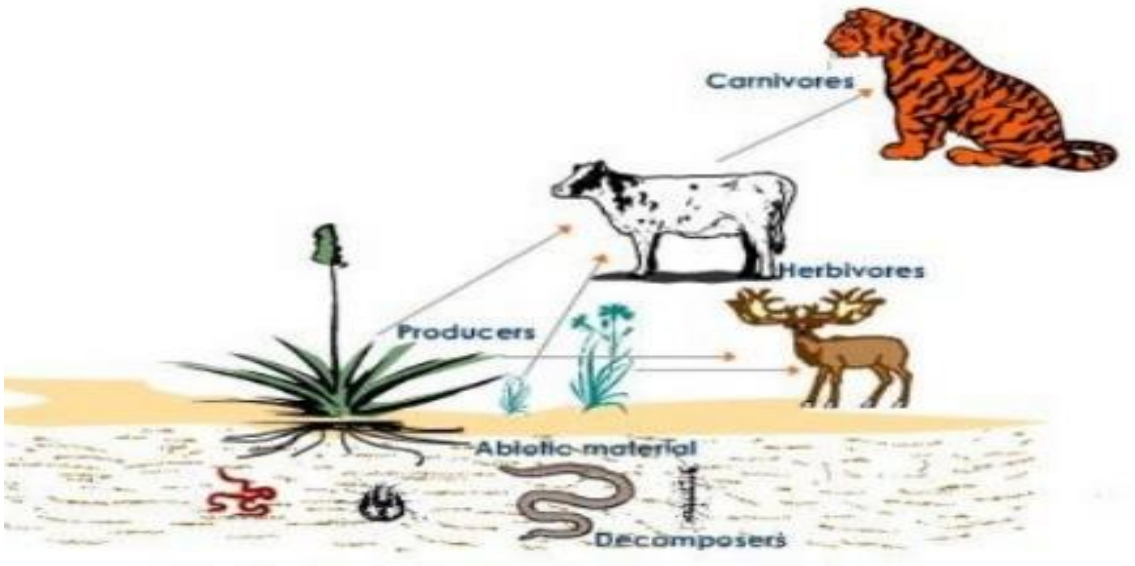
(III) Decomposers: The organic matter of the grassland is decomposed by the microbes like actinomycetes, fungi (Mucor, Aspergillus, Rhizopus, Penincillium, and Cladosporium), aerobic and anaerobic soil bacteria etc. They release the minerals back into the soil thus making the soil fertile.

Functions of the Grassland Ecosystem

The primary function of an ecosystem is productivity. The producers fix the solar energy and produce the complex organic matter with the help of minerals. It provides forage for livestock, protection and conservation of soil and water resources, furnishing a habitat for wildlife, both flora and fauna and (contribution to the attractiveness of the landscape. The functional aspects of the Grassland can be studied by two means:

1. Food Chain in an ecosystem: There is an important feature of the ecosystem that one level of an organism serves as food for another level of the organism. A series is formed which is known as Food Chain. In an ecosystem, the food chain does not follow the linear pattern, but an organism may feed upon more than one organism in the same food chain or upon organisms of different food chains. Thus interconnected food chain system is formed known as a food web.

2. Nutrient cycle in an ecosystem: For any ecosystem to be successful, it is important that the constituent materials move in a cyclic manner. The producers (green plant) takes up the mineral elements from the soil and air, convert them into organic form and after passing through the different trophic levels, are again returned to the soil and air.



Topic-3

Conservation of Biodiversity National and Global

Nature with its rich resource has showered this planet with variety of living beings which is called as Biodiversity. Biological diversity' means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems. To manage such a huge number and types of Bio diversities it was essential to design a suitable platform with a common perspective, plan and motto. There was an urgent need to conserve the Biodiversity which was gradually replenishing. Conservation of biological diversity and sustainable use of its components came into the limelight in 1972 (United Nations Conference on Human Environment; Stockholm). In 1973, UNEP identified conservation of biodiversity as a priority area, hence there was need to get the legal mandate for conservation of world resources. There were negotiations for a legally binding instrument to address biological diversity and its loss to enhance fairness and equity in sharing of the benefits of biodiversity; this led to the opening of the Convention on Biological Diversity in 1992; Rio de Janeiro under the United Nations Conference on Environment and Development (UNCED)/ Earth Summit. The convention was inspired by the growing concern all over the world for sustainable development. The convention objectives were:

• Conservation of the biological diversity;

• Sustainable use of its components;

• A fair and equitable sharing of its benefits.

This was the first global comprehensive agreement that addressed all the aspects of biological diversity; genetic resources, species diversity and ecosystem diversity.

Edward Wilson coined this term for the first time. Conservation of biodiversity can be studied in different segments. They are:

Genetic diversity

Species diversity

Ecological/Ecosystem diversity

This incorporates the preservation, maintenance, sustainable use (conservation), recovery and enhancement of the components of biological diversity.

Sustainable development

This refers to development that meets the needs of the current generation without compromising the ability of future generations to meet their needs; it simply refers to intra and intergenerational equity. A balance between the environment, development and society results to sustainable development which ensures biodiversity conservation. This is only

possible in the presence of good enforced and implemented policies/ conventions, environmental institutions and political stability among others conservation measures of biodiversity

Types of Conservation:

Conservation can broadly be divided into two types:

1. In-situ conservation

2. Ex-situ conservation

1. In-situ conservation

In-situ conservation is on site conservation or the conservation of genetic resources in natural populations of plant or animal species, such as forest genetic resources in natural populations of tree species. It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself, or by defending the species from predators.It is applied to conservation of agricultural biodiversity in agro forestry by farmers, especially those using unconventional farming practices. In-situ conservation is being done by declaring area as protected area.This also refers to conservation of ecosystems and natural habitats including maintenance and recovery of viable populations of species in their natural habitats.

In order to conserve Biodiversity as In situ conservation various measures have been undertaken. This constitutes:

a) Development of Protected areas as National Park. Wild life sanctuaries and Biosphere reserve

b) Sacred forests and reserves

INDIA has over 600 protected areas, which includes over 90 national parks, over 500 animal sanctuaries and 15 biosphere reserves.

1. National Parks:

A national park is an area which is strictly reserved for the betterment of the wildlife and where activities like forestry, grazing on cultivation are not permitted. In these parks, even private ownership rights are not allowed. Corbett National Park, Uttarakhand

2. Wildlife Sanctuaries:

A sanctuary is a protected area which is reserved for the conservation of only animals

Ghana Bird Sanctuary.Rajasthan

3. Biosphere Reserves:

It is a special category of protected areas where human population also forms a part of the system. Nanda Devi, Uttarakhand.

2. Ex-situ conservation

Ex-situ conservation is the preservation of components of biological diversity outside their natural habitats. This involves conservation of genetic resources, as well as wild and cultivated or species, and draws on a diverse body of techniques and facilities. Such strategies include establishment of botanical gardens, zoos, conservation strands and gene, pollen seed, seedling, tissue culture and DNA banks. This also refers to conservation of components of biodiversity outside their natural habitats, e.g. zoos, museums, gene banks, botanic gardens/arboretums; Used for threatened and endangered species to avoid their extinction; also known as captive conservation. This also includes development of Tissue culture lab and Lab for cryoconservation of germplasm.

1. Seed gene bank:

These are cold storages where seeds are kept under controlled temperature and humidity for storage and this is easiest way to store the germ plasma of plants at low temperature.

2. Gene bank:

Genetic variability also is preserved by gene bank under normal growing conditions. These are cold storages where germ plam are kept under controlled temperature and humidity for storage; this is an important way of preserving the genetic resources.

3. Cryopreservation:

. This type of conservation is done at very low temperature (196°C) in liquid nitrogen.

4. Tissue culture bank:

Cryopreservation is a method where organelles, tissues, organs susceptible for damage are preserved by cooling at very low temperature. Long term culture of excised roots and shoots are maintained. Meristem culture is very popular in plant propagation as it’s a virus and disease-free method of multiplication.

5. Long term captive breeding:

The method involves capture, maintenance and captive breeding on long term basis of individuals of the endangered species which have lost their habitat permanently or certain highly unfavorable conditions are present in their habitat.

6.. Botanical gardens:

A botanical garden is a place where flowers, fruits and vegetables are grown. The botanical gardens provide beauty and calm environment. Most of them have started keeping exotic plants for educational and research purposes.

7. Zoological Gardens:

In zoos wild animals are maintained in captivity and conservation of wild animals (rare, endangered species) takes place. In India, the 1st zoo came into existence at BARRACKPORE in 1800. In world there are about 800 zoos. Such zoos have about 3000 species of vertebrates. Some zoos have undertaken captive breeding programmes.

Species and ecosystems are seldom neatly confined within national boundaries. Many species roam across countless national borders and the oceans are owned by none. Trade in endangered species (or parts thereof) is international and pollution produced on one side of the world may wind up affecting regions on the other side of the globe. Biodiversity conservation is thus an international problem requiring international solutions.

Conservation at International level

The role of international conservation organisations is a vital one, particularly in terms of brokering international agreements between governments concerned with protecting their national interests. The most far-reaching agreement on biodiversity in recent years is the Convention on Biodiversity, signed by 156 nations at the United Nations Conference on Environment and Development (the Earth Summit) in Rio in 1992. Many others have signed since, and as they ratify the convention, governments accept responsibility for safeguarding biodiversity in their nations. Many international conservation organisations including WRI

(World Resources Institute) and IUCN (The World Conservation Union) contributed to the formulation of the documents signed at the convention.

The UK was one of the first countries to follow up its commitment under the Convention on Biodiversity. The UK Action Plan was published in January 1994. A UK Biodiversity Steering Group was appointed, which published a report entitled Meeting the Rio Challenge in 1995. The report contains action plans for over 100 endangered species and 14 key habitats, together with a commitment to produce further plans. The Steering Group proposed the use of a standard methodology for the production of local biodiversity action plans. These would be based upon the priorities of the UK plan, but would be supplemented by local priorities.

Action Plans seek to apply principles of business planning to a strategic view of the environment. They identify objectives, set quantified targets and define the actions needed to reach those targets. Nature of Devon - A Biodiversity Action Plan is Devon's response to this national biodiversity planning process. This regional process is going on throughout England. The sum of all the regional Biodiversity Action Plans should add up to the full UK Biodiversity Action Plan.

International conservation organisations play an important role in the wide publicising of environmental information. IUCN was responsible for the idea of compiling lists of threatened species as a means of drawing attention to the plight of species faced with extinction. These lists became known as Red Data Books (RDBs). In these, species are placed into one of several categories which range from 'extinct' to 'vulnerable' or 'rare', depending on the degree of threat to their existence. The first internationally applicable RDB was published in 1996. The 'red' stands for 'danger' and the concept has since been adopted by many different countries, including Britain. RDBs point the way for government agencies charged with environmental protection, as well as for non-governmental organisations (NGOs) concerned about maintaining diversity.

Organisations such as WWF, founded in 1961 by Sir Peter Scott, the eminent naturalist, are highly effective in publicising the plight of endangered species world-wide. They also play a large role in raising charitable funds towards projects concerned with saving wildlife in various areas of the globe. Many such conservation organisations pay for the basic resources

needed by under-developed countries to enforce their laws. This can be as basic as providing a means of transport and salaries for enforcement officers. However, how effective these campaigns and projects are in the long run remains to be seen. Loss of habitat is still the most pressing problem.

In some areas, biodiversity is seriously threatened as a result of trade in endangered species. The international trade in wildlife is estimated to be worth £12 billion a year. Up to a quarter of that trade is almost certainly illegal. The main piece of legislation limiting trade in endangered species is CITES (the Convention on International Trade in Endangered Species). This is a UN convention which came into effect in 1975. CITES prohibits commercial trade in endangered species of plants and animals. Legitimate international trade in species which are not now threatened, but which may become so if trade is not controlled, is allowed via a permit system. Responsibility for implementing it lies with signatory nations.

Many of the problems involved in protecting habitats and species arise because local people either need to use the resources available in sensitive habitats to provide the necessities for subsistence or survival, or traditionally have always done so. UNESCO (United Nations Educational, Scientific and Cultural Organisation), through its 'Man and the Biosphere' programme, has set up a number of Internationally recognised biosphere reserves in an attempt to address this problem.