ENVIRONMENTAL STUDIES

Unit I

Environment, Ecology, Biodiversity:

Definition, Scope and importance, Multidisciplinary nature of Environmental studies, Concept of an ecosystem, Biotic and Abiotic component of an ecosystem and its interaction, Food chain and food web, Energy flow and material cycling in ecosystem, Balanced eco system, Biodiversity- Ecological Value of biodiversity, Threats to biodiversity and Conservation of Biodiversity, Concept of Sustainable Development: Definition, objectives and applications.

1.1 Environment

Environmental science is the study of nature and the facts about environment. Environment can be defined as "all the social, economic, physical and chemical factors that surrounds man" or "all abiotic and biotic components around man-all living and non-living things surrounds man".

1.1.1 Prerequisite Discussions

The word environment is derived from the French word ‘environer’ which means to ‘encircle or surround’.

Objective of this course is to develop concern for our own environment which will lead us to act at our own level to protect the environment we all live in.

Ever since people first recognized that their health and well-being were related to the quality of their environment, they have applied thoughtful principles to attempt to improve the quality of their environment.

There are three reasons for studying the state of the environment.

- The first is the need for information that clarifies modern environmental concepts like equitable use of natural resources, more sustainable life styles etc.
- Second, there is a need to change the way in which we view our own environment, using practical approach based on observation and self-learning.
- Third, there is a need to create a concern for our environment that will trigger pro-environmental action; including simple activities we can do in our daily life to protect it.

1.1.2 Concepts

According to ancient man the environment was the Panchaboodhas (i.e.) air, water, land, sky and energy(Sun).

The human were disciples of nature. They were able to protect themselves from harmful one and protect the others. But according to modern man the environment is only air land and water.

Exploitation of various earth resources to satisfy the increasing needs of human population has resulted in 1) depletion of various resources of earth 2) pollution. Principles of environmental education:

- Examine the major environmental issues

- Discover the root cause
- Develop problem solving skills
- Promote co-operation in solving problems
- Emphasis active participation in prevention and solution to problems

1.1.3 Scope of Environmental Science

- Studying the interrelationship between the components of environment.
- Carrying out impact analysis and Environmental Audit
- Preventing pollution from existing and new industries
- Stopping the use of biological and nuclear weapons
- Managing unpredictable disasters etc.

1.1.4 Public Awareness:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection.

- Public awareness of environmental issue is at infant stage
- 30-40% of public of developing country are aware of environmental. Problems but they do not bother about it.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in std. of living has lead to serious environmental
- disasters.
- Debates on environmental Issues are treated as anti-developmental.

1.1.5 Application:

- Environmental science is essentially the application of scientific methods and principles to the study of environmental issues, so it has probably been around in some forms as long as science itself.
- Environmental science is often confused with other fields of related interest, especially ecology, environmental studies, environmental education and environmental engineering.
- Environmental science is not constrained with any one discipline and it is a comprehensive field.

1.2 Multidisciplinary nature of Environmental studies:

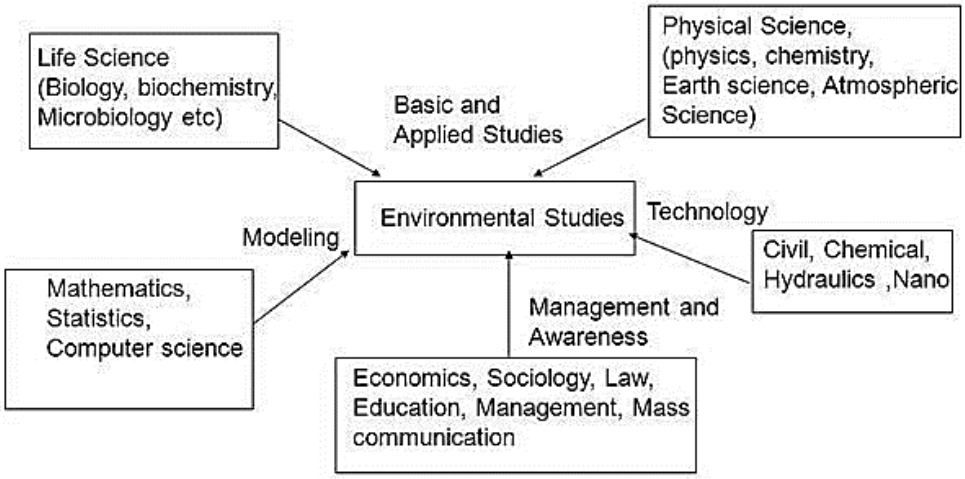
Because, the environment is complex and actually made up of many different environments, including natural, constructed and cultural environments, environmental studies is the inter disciplinary examination of how biology, geology, politics policy studies, law, geology, religion engineering, chemistry and economics combine to inform the consideration of humanity's effects on the natural world.

This subject educates the students to appreciate the complexity of environmental issues and citizens and experts in many fields. By studying environmental science, students may develop a breadth

of the interdisciplinary and methodological knowledge in the environmental fields that enables them to facilitate the definition and solution of environmental problems.

It is essentially a multidisciplinary approach and its components include Biology, Geology, Chemistry, Physics, Engineering, Sociology, Health Sciences, Anthropology, Economics, Statistics and Philosophy. It is essentially a multidisciplinary approach. An Understanding of the working of the environment requires the knowledge from wide ranging fields.

The multidisciplinary nature of environmental science is illustrated in following diagram



1.3 Concept of an ecosystem:

1.3.1 Ecosystem

Living organisms cannot be isolated from their non-living environment because the later provides materials and energy for the survival of the farmer.

An ecosystem is therefore defined as a natural functional ecological unit comprising of living organisms and their non-living environment that interact to form a stable self-supporting system.

1.3.2 Concepts

Ecology is the study of the distribution and abundance of organisms, the flows of energy and materials between abiotic and biotic components of ecosystems.

Structure of Ecosystem

1. Biotic or Living components
2. Abiotic or non-living components or physical components
3. Energy components

Earth environment:

1. Lithosphere (land)

2. Hydrosphere (Water)
3. Atmosphere (Air)
4. Biosphere (Flora/Fauna/Microbes)
5. Anthrosphere (Man made things)

Function of organisms in an ecosystem

- Producer (autotrophy): make food; plants, algae
- Consumer (heterotrophy): eat other organisms
- Decomposer: eat dead organic matter; bacteria and fungi

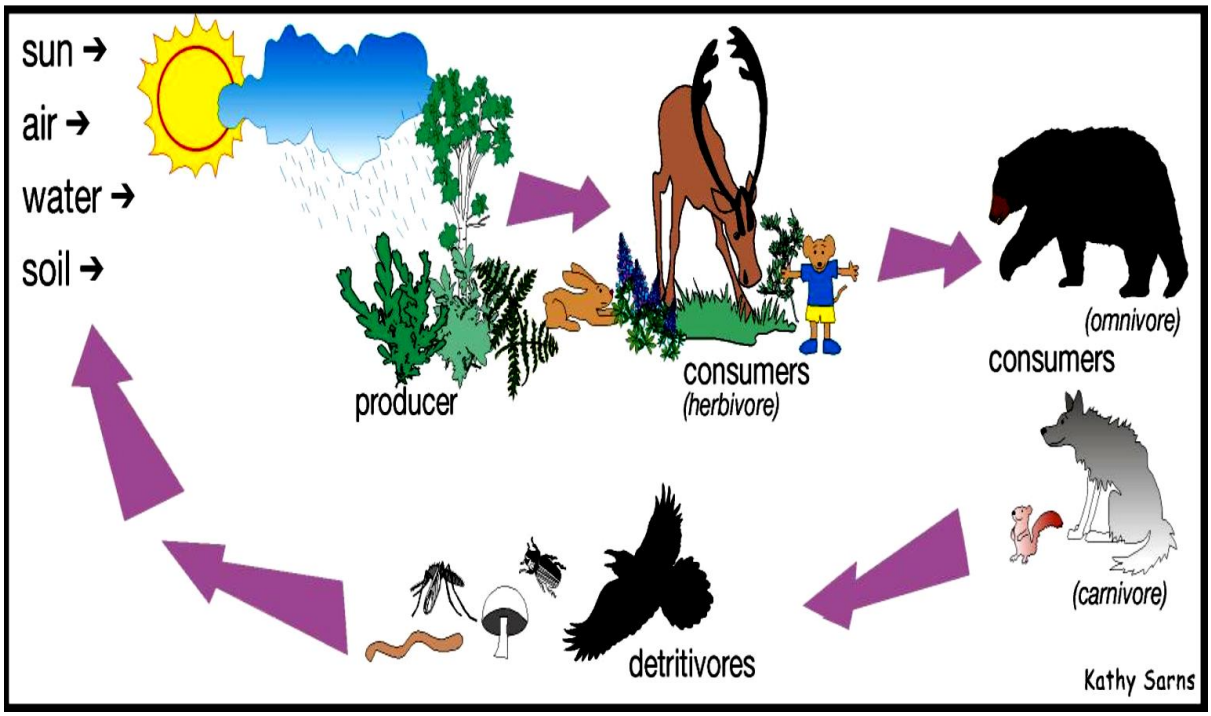
Classes of Consumers

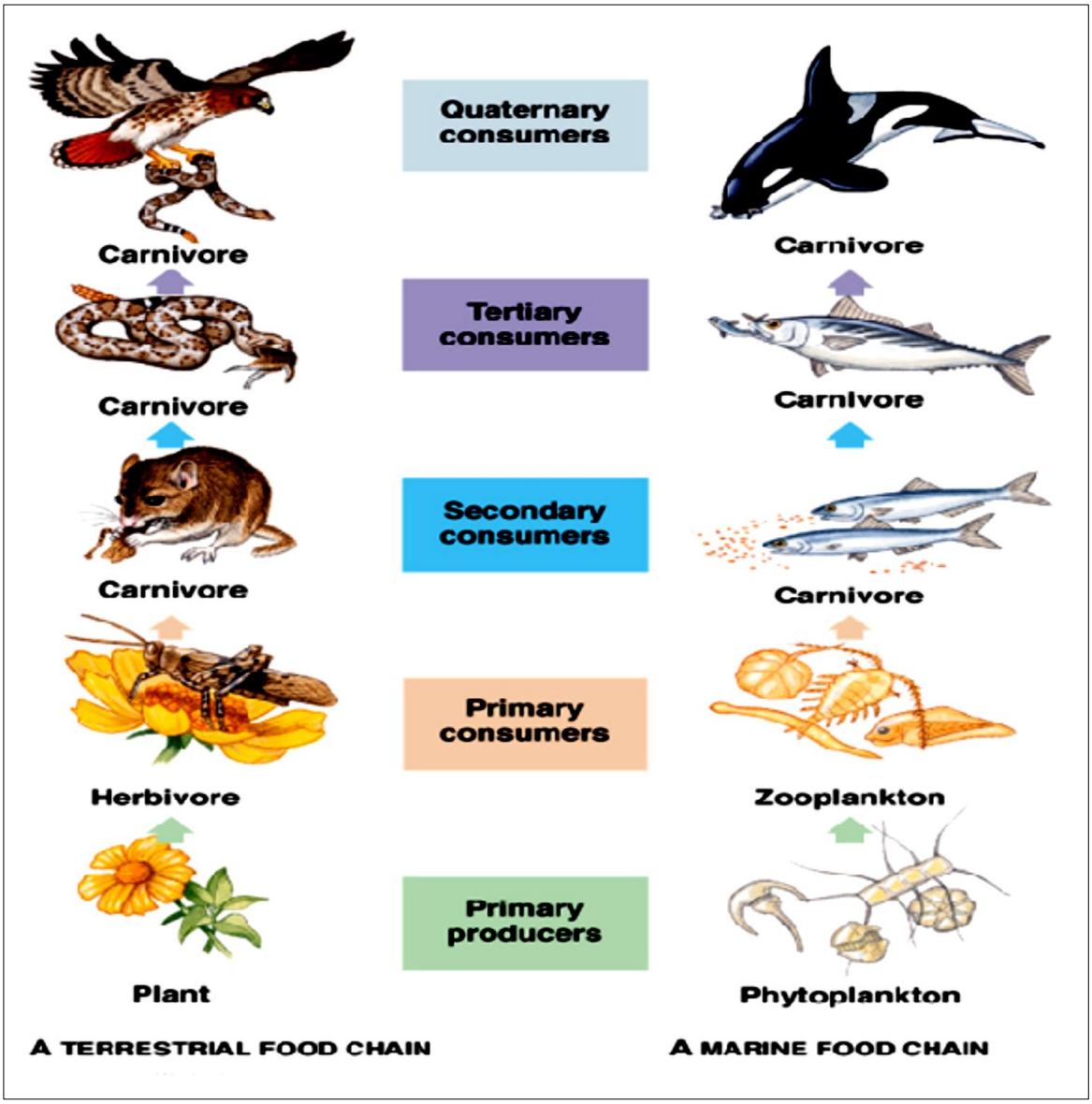
- Herbivore – primary consumer – eats plants
- Carnivores – secondary – meat eaters; eat herbivores
- Tertiary – feed on carnivores
- Omnivores – eat plants/animals

1.4 Food Chain

Plants by photosynthesis convert solar energy into protoplasm. Small herbivores consume the vegetable matter and convert into animal matter which in turn eaten by large carnivores.

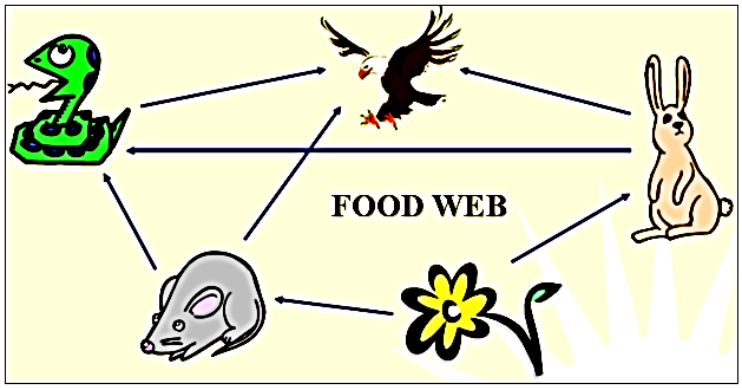
- A food chain may be defined as, "the transfer of energy and nutrients through a series of organisms with repeated process of eating and being eaten".
- In an ecosystem, all the organisms are linked together with one another by food relationship.
- Each organism living or dead is potential food for some other organism.





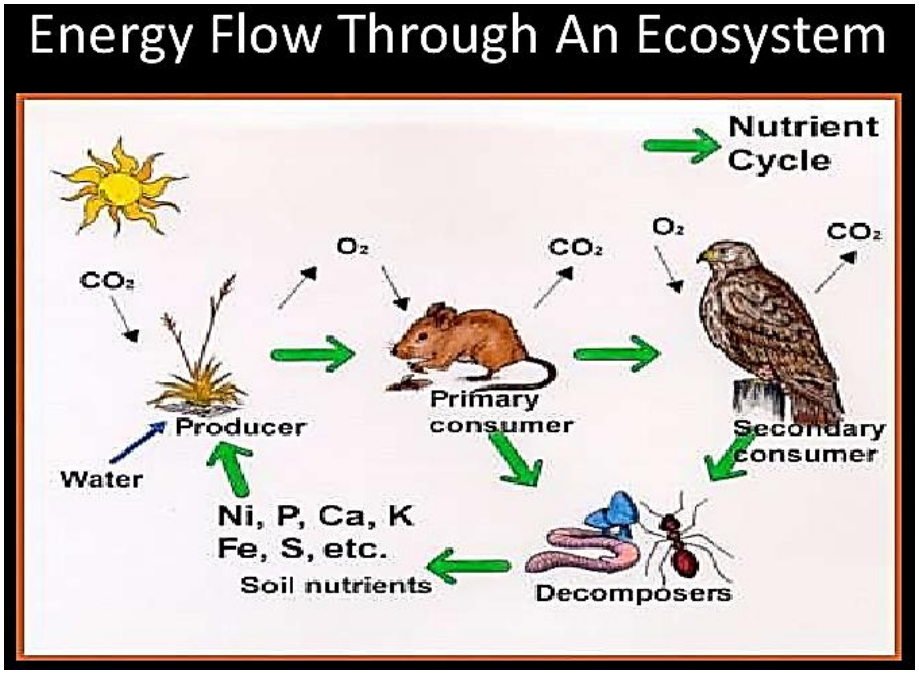
1.5 Food Web

The food relationship between various organisms is being depicted by linking all the possible prey and predators of different food level. In an ecosystem linking of feeding habit relations will provide a food web or Interlocking pattern of several interlinked food chains is termed as FOOD WEB.



1.6 Energy Flow in Ecosystem

- All organisms must obtain a supply of energy and nutrients from their environment in order to survive.
- The transformations of energy in an ecosystem begin first with the input of energy from the sun.
- Because, it is the first step in the production of energy for living things, it is called "Primary production".
- Photosynthesis -- Chemical reaction where green plants use water & carbon dioxide to store the sun's energy in glucose.
- ENERGY is stored in glucose.
- Glucose is stored as starch in plants
- The majority of autotrophs are photoautotrophs that harness the energy of the sun and pass some of this energy onto consumers through feeding pathways.
- The energy contained within producers and consumers is ultimately passed to the decomposers that are responsible for the constant recycling of nutrients.
- Thus, there is a one-way flow of energy through the biotic community and a cycling of nutrients between the biotic and abiotic components of the ecosystem
- Energy flow cannot occur in reverse direction.
- Starts from autotrophs (the producer level, i.e., first trophic level) to Heterotrophs including plant eaters or Herbivores (second trophic level) and so on.
- The amount of energy decreases with successive trophic levels.
- Only About 1% of energy from the sun is used by green plants & rest remains unutilized.
- Similarly, there is loss of energy in each trophic level.
- The transfer of food energy between the organisms in an ecosystem can be tracked by constructing food chains, food webs, pyramids of numbers, biomass and energy and energy flow diagrams.



1.7 Balanced eco system:

An **ecosystem** is **balanced** when the natural animals and plants and non-living components are in harmony- i.e. there is nothing to disturb the **balance**. With increasing pollution, change in migratory patterns, and rise of human population, many **ecosystems** are in danger of losing that harmony.

1.8 Biodiversity

Biodiversity is the variety and differences among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part.

1.8.1 Concepts: Levels of Biodiversity

1) **Genetic diversity:** It is a level of biodiversity that refers to the total number of genetic characteristics in the genetic makeup of a species.
2) **Species diversity:** It refers to the variety of species within a region. Species diversity is an index that incorporates the number of species in an area and also their relative abundance.
3) **Ecosystem diversity:** It refers to the diversity of a place at the level of ecosystems.

1.8.2 Ecological Value of biodiversity:

1. Consumptive use:

Drugs: Many plants are used in primary health care. 70% of modern medicines are derived from plant and plant extracts.

Penicillin – fungus is the source – Antibiotic

Quinine – Chincona bark - Malaria treatment

Morphine – Poppy bark – Analgesic

Fuels: Fire woods are directly consumed by villagers.

Food: A large number of wild plants and wild animals are consumed by human beings as food.

2.Productive use:

Biodiversity products have commercial value. These products are marketed and sold. These are derived from animals and plants.

Animal products: Silk from silk worm, Wool from sheep, Musk from musk deer, Leather from animals

Plant Products: Wood for paper and Plywood, Cotton for textile industry, Pearl for pearl industry

3.Social value:

It refers to the manner in which the bio-resources are used in the society. These are associated with the social life, religion and spiritual aspects of the people.

e.g., Holy plants: Tulsi, Lotus, Neem trees

Holy animals: Cow, snake, bull, peacock

4.Ethical value:

It means that a species may or may not be used but its existence in nature gives us pleasure.

e.g., Holy river: River Ganga

Holy tree: Tulsi, Vengai

5.Aesthetic value:

The beautiful nature of plants and animals insists us to protect the biodiversity. Ex) eco-tourism, colour of butterfly, flowers etc.

6.Optional value:

The optional value of biodiversity suggests that any species may be proved to be a valuable species after someday.

1.8.3 Threats to biodiversity and Conservation of Biodiversity

Threat to biodiversity stems mainly from: habitat fragmentation, degradation and loss; shrinking genetic diversity; invasive alien species; declining forest resource base; climate change and desertification; over exploitation of resources; impact of development projects; and impact of pollution.

The table below summarize the main threats occurring:	
Threats in terrestrial areas	**Some underlying causes**
Degradation, destruction and fragmentation of natural habitats	Spread of the urbanised areas, road network and industrial areas and associated problems (noise, pollution); abandon of former agricultural practices that were favourable to biodiversity
Decrease in the capacity of the agricultural areas to host wildlife	Intensification of agricultural practices (yielding pollution and disturbance) and disappearance of landscape elements that provide food and shelter that are exploitable by wildlife (such as hedges, trees, ponds, etc.)
Pollution of soils, air and water	Excess of heavy metals (industry, roads), manure and pesticides (agriculture) and other pollutants
Invasions by alien species	International trade and transport (roads, railways, rivers), gardening practices, exotic trees in forestry, exotic pests released in the wild, climate change, etc.
Epidemics affecting wildlife	Arrivals of pathogens that are favoured by the introduction of exotic species, pollution and the destruction of habitats
Climate change	Carbon emissions, deforestation and other land use changes due to human activities
Dessication of soils and wetlands	Excess pumping of underground water tables
Recreation and leisure	Overuse of green open spaces and wild areas, little respect for nature, mountain biking and motor sports in fragile areas, dogs not on leash
Threats in marine areas	
Overfishing and decline of species	Industrial fishing, overexploitation of target species, by-catch species
Pollution and eutrophication traffic	Land-based activities (river run-off), atmospheric deposition, maritime
Degradation and destruction of the sea floor	Beam trawling, dredging, sand and gravel extraction
Alien species introductions	Maritime trade (ballast waters, fouling), leisure navigation, mariculture, climate change

1.8.4 Endangered and Endemic Species of India

- According to The International Union of Conservation of Nature and Natural Resources (IUCN), the species that considered in imminent danger of extinction and whose survival is unlikely, if factors causing their decline continue to operate.
- Out of about 47,000 species of plants in our country, 7000 are endemic
- India contains 172 species of animals considered globally threatened by IUCN, or 2.9% of the world's total number of threatened species.
- These include 53 species of mammals, 69 birds, 23 reptiles and 3 amphibians.
- As many as 3,000- 4,000 higher plants may be under high degree of threat in India.

- Thus Indian subcontinent has about 62% endemic flora, restricted mainly to Himalayas, khasi Hills & Western Ghats.
- Sapria himalayana, Uvaria lurida, Napenthes khasians etc. are some endemic flora of our country.
- A large number out of a total of 81,000 species of animals in our country is endemic.
- About62% amphibians and 50% lizards are endemic to western Ghats.
- Golden monkey, Niligiri Langur, Indian Wolf, Red Fox, Himalayan Brown Bear, Great Indian One Horned Rhinoceros, White Winged Wood Duck, Black Necked Crane, Indian Pea Fowl, Gharial, Indian egg eating Snake, Indian Salamandar etc. are some examples of endemic animal species of India.

1.8.5 Conservation of Biodiversity

In general biodiversity is generally disturbed by human activities. To solve the problems, it is essential to protect our bio diversity by two ways.

1. In-situ or on-site conversion
2. Ex-situ conservation

In-situ conservation:

- Conservation of species in its natural habitat, in place where the species normally occurs
- The strategy involves establishing small or large protected areas, called protected areas
- Today in world, there are 9800 protected areas and 1500 national parks

Methods:

1. Nature or biosphere reserves (Eg) Nilgiri Bio reserve
2. National parks and sanctuaries (Eg) Mudumalai, vedanthangal
3. On farm and home garden conservation for plants, vegetables and fruits to maintain traditional crop varieties.

Ex- situ conservation:

- It involves maintenance and breeding of endangered plant and animal species under partially or wholly controlled conditions in zoos, gardens and laboratories
- The crucial issue for conservation is to identify those species which are more at risk of extinction.

Methods:

1. Long term captive breeding
2. Shortage term propagation and release
3. Animal translocation and re introductions
4. Seed bank
5. Reproductive technology
   i. Embryo transfer technology
   ii. Cloning

1.9 Sustainable Development:

Sustainable development has been defined as “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

In other words, when people make decisions about how to use the Earth's resources such as forests, water, minerals, wildlife, etc. they must take into account not only how much of these resources they are using, what processes they used to get these resources, and who has access to these resources.

1.9.1 Concept of sustainable development

- A symbiotic relationship between consumer human race and producer natural system
- Compatibility between ecology and economics

1.9.2 Aim of sustainable development

- Inter-generational equity
- Intr- generational technology

1.9.3 Significance of sustainable development

- Reduce, reuse and recycle of natural resources
- Providing environmental education and awareness
- Consumption of renewable resources
- Conservation of non-renewable resources
- Population control