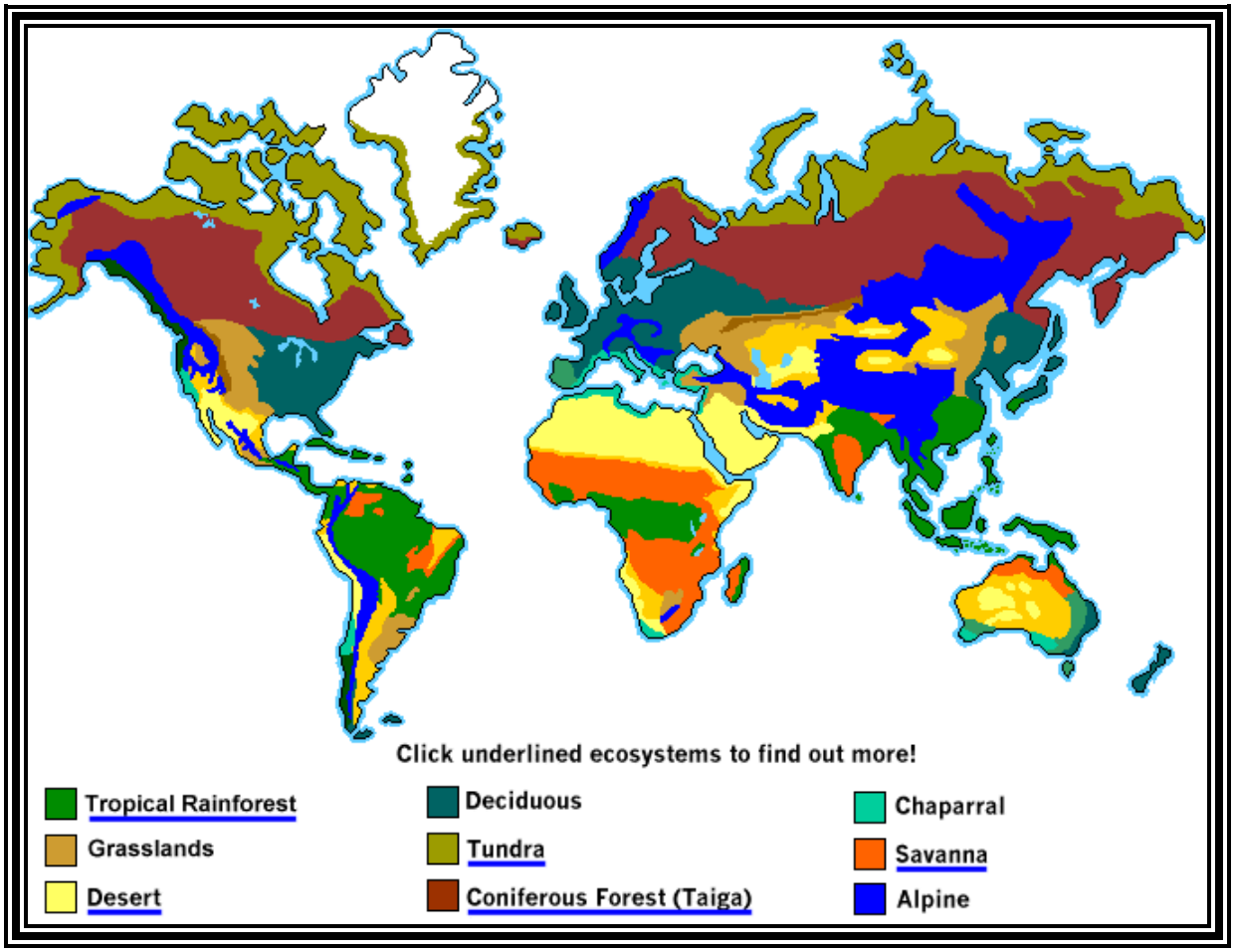
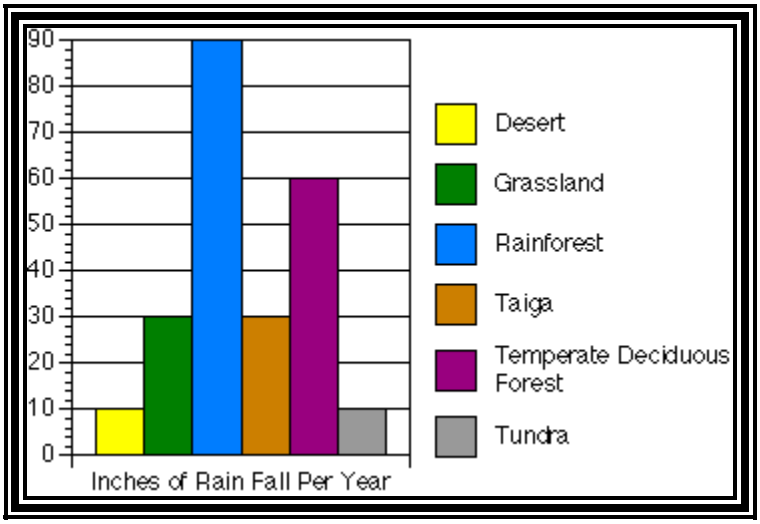
ENVIRONMENTAL BIOLOGY

ECOSYSTEM;

All living and non-living components present in this planet interact among themselves and also environment-sun rays, wind and temperature exist together in a dynamic state. Such an organization or assemblage is called an Ecosystem. For that matter, the entire earth with all its components is considered as a giant ecosystem or giant Biosphere (bio=life forms, sphere = an area occupied).





RAIN FALL

The ecosystem existing on this planet is very vast and varied, in their structure, components and functions. Based on the habitat and dominant life forms existing in a particular area, different kinds of ecosystems have been identified.

CONSTITUENTS OF ECOSYSTEMS:

Every ecosystem, big or small, is always made up of two major components. They are structural components and functional components.

A. Structural Components:

Structural components consist of living organisms and non-living structures. The former is called biotic and the latter is called abiotic. They exist together interact with each other in building up or reclaiming the system.

i) Biotic components: All living organisms from viruses-bacteria, and fungi, plants to animals are included under Biotic structural elements. This includes detritivores also. However, the biotic components vary from system to system.

ii) Abiotic components: They are the inert matter found on earth. Soil and its constituents, water and its constituents, temperature of the atmosphere, rainfall, atmospheric moisture, gases, wind, light, etc, all form abiotic contents.

B. Functional Components:

Living organisms and non-living matter in any ecosystem do not exist in isolation and function all independent. Most of the abiotic constituents provide raw materials, energy sources etc. for the living organisms to consume and produce the organic matter.

The functional components are mainly the processes involved in the flow of energy (solar energy), from abiotic components (including nutrients) into biotic components (as biomass), from one biotic to another biotic system and lastly from biotic back to abiotic system.

The success of an ecosystem mainly depends upon the longevity (or half life) of the bioenergy retained within the biomass. The half life of the bioenergy in a biomass in turn is controlled by the rate of producer's

activity, the rate of consumer's activity, the rate of detritivores activity and rate at which these three interact with each other.

The major functional process of an ecosystem is autotrophic mechanisms, by which Solar energy is converted into chemical energy as the main capital. Using such energy and other abiotic ingredients biomass is built up by various respiratory, and intermediary metabolic process, responsible for the growth of biomass. Lastly the biomass (after death) is converted by various oxidative processes into basic abiotic ingredients and there is a net loss of energy in the form of heat. All bio-geo- chemical cycles are involved in this. In all these energy transformations, there is a loss of energy in one or the other form; thus, they obey the second law of thermodynamics. It is the functional process that ultimately determines the success of biosystem in an ecosystem.

BIOMASS / BIOENERGY:

Biomass:

Living organisms are made up of various organic compounds like carbohydrates, fats, proteins, etc. All of them contain energy in their chemical bonds. The total organic matter (usually dry weight) of all living organism found in any given area, at a given time, is called Biomass. The production and the ability to produce biomass depend upon the structural and functional components of an ecosystem.

Bioenergy: The chemical energy present in the organic materials found in biomass is called Bioenergy. It has been estimated that one-gram molecular weight of the organic matter of biomass (dry wt) contains about 42 K. Calories of energy. Such energy is called Bioenergy.

Biopotential: In many ecosystems, the producers are consumed continuously. If this goes on without replenishment of additional producers the biotic components perish. However, producers keep on producing more organic matter. Some produce more than the others.

The ability of the plants to produce certain number of organic components in a given time is called Biopotential. In this context the phytoplankton in aquatic systems have very high biopotential.

TROPHIC LEVELS AND ECOLOGICAL PYRAMIDS

All the existing biotic components in any ecosystem can be grouped into producers, consumers and detritivores. Producers may be primary or secondary. Similarly, the consumers can be grouped into primary, secondary and tertiary kinds. Each of them can be quantified in terms of number, biomass or energy. Such grouping is called Trophs and relationally they can be organized into trophic levels.

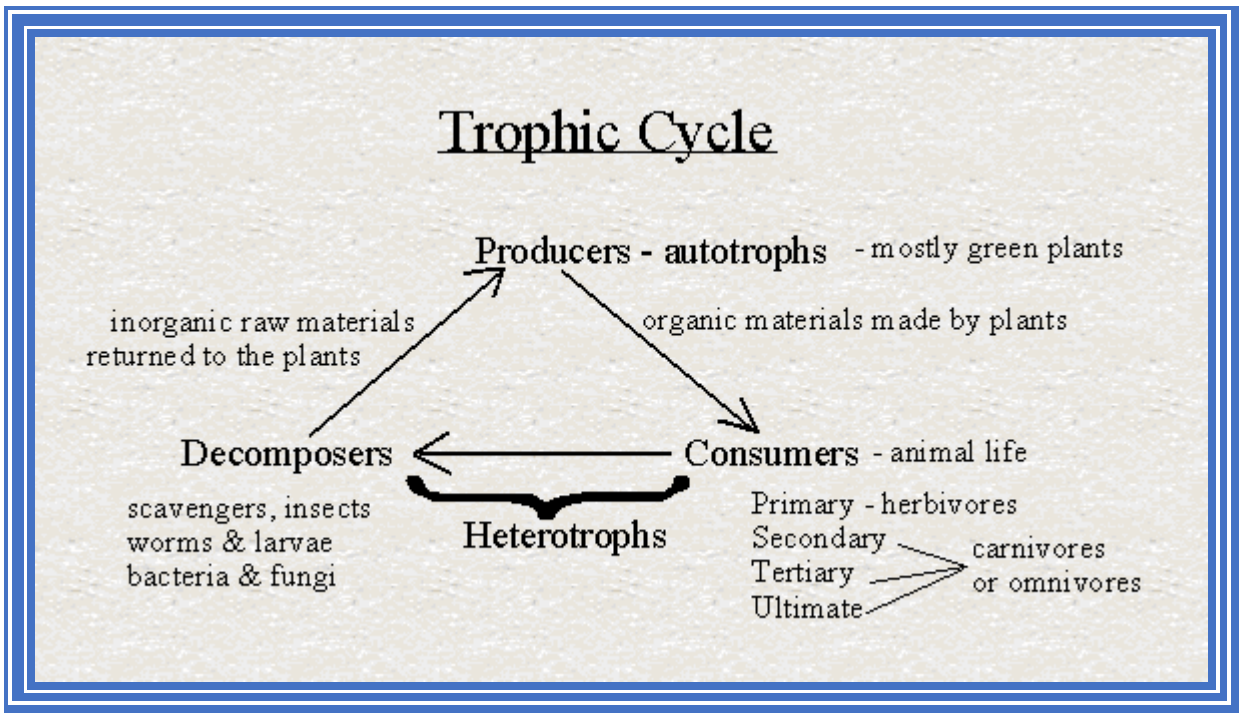
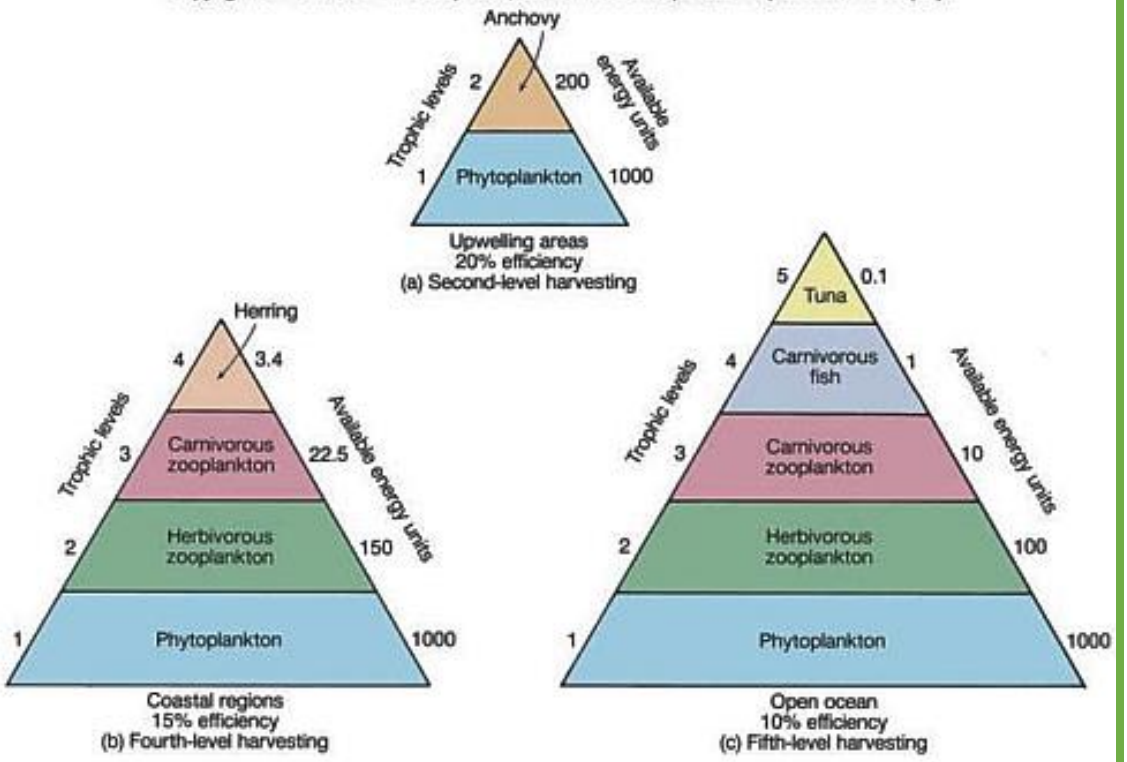
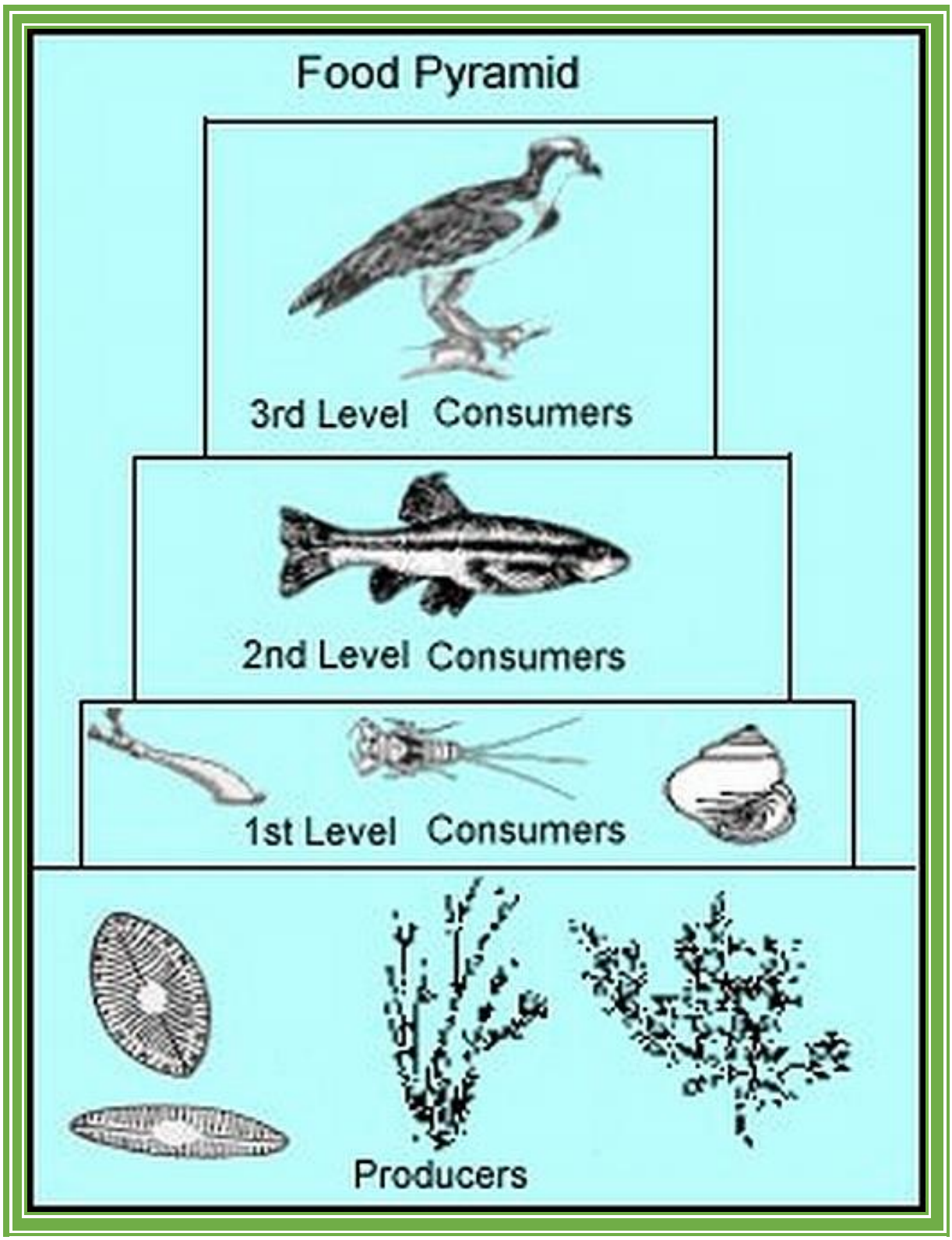
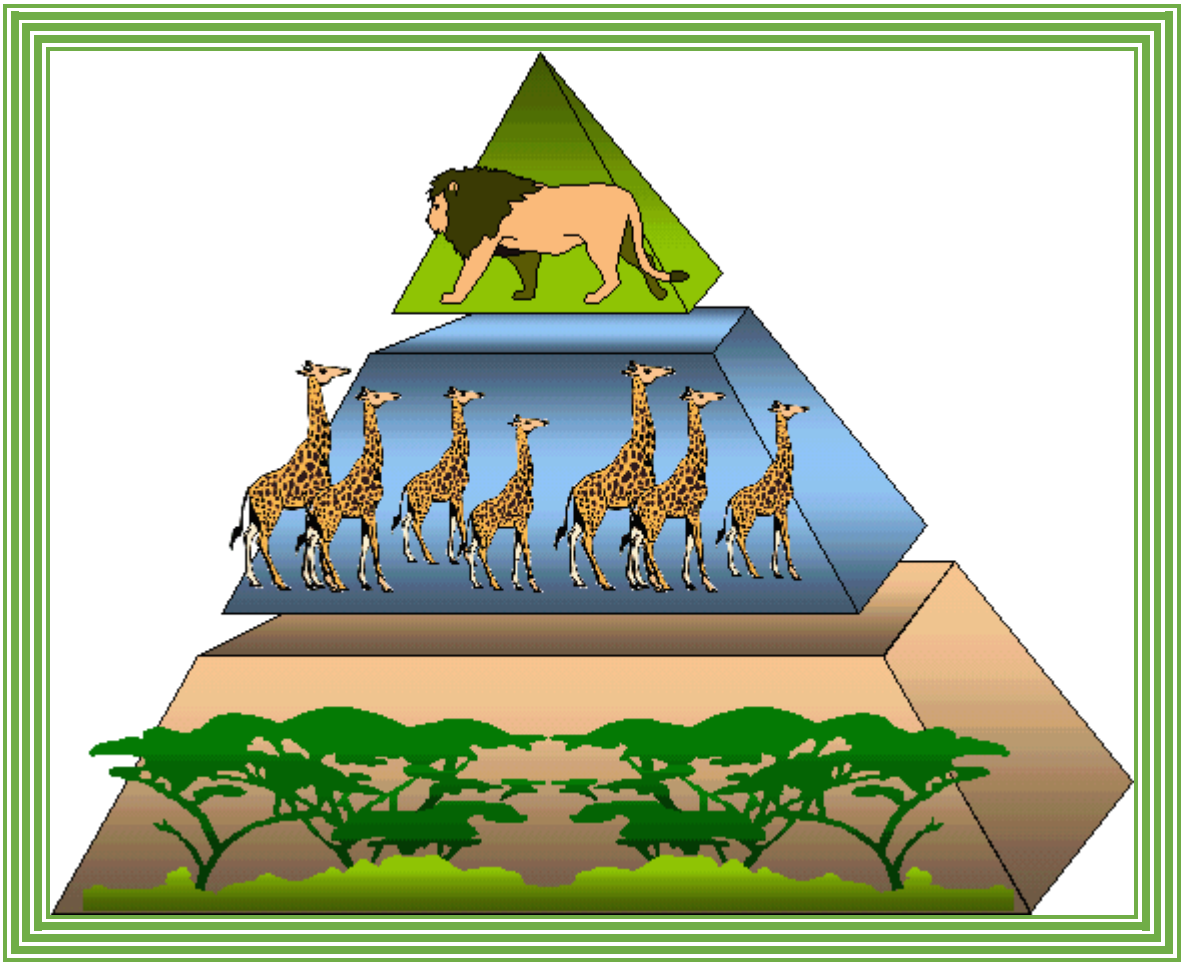

Trophic Cycle
Producers - autotrophs
- mostly green plants
inorganic raw materials
returned to the plants
organic materials made by plants
Decomposers
Consumers
- animal life
scavengers, insects
worms & larvae
bacteria & fungi
Heterotrophs
Primary - herbivores
Secondary
Tertiary
Ultimate
carnivores
or omnivores

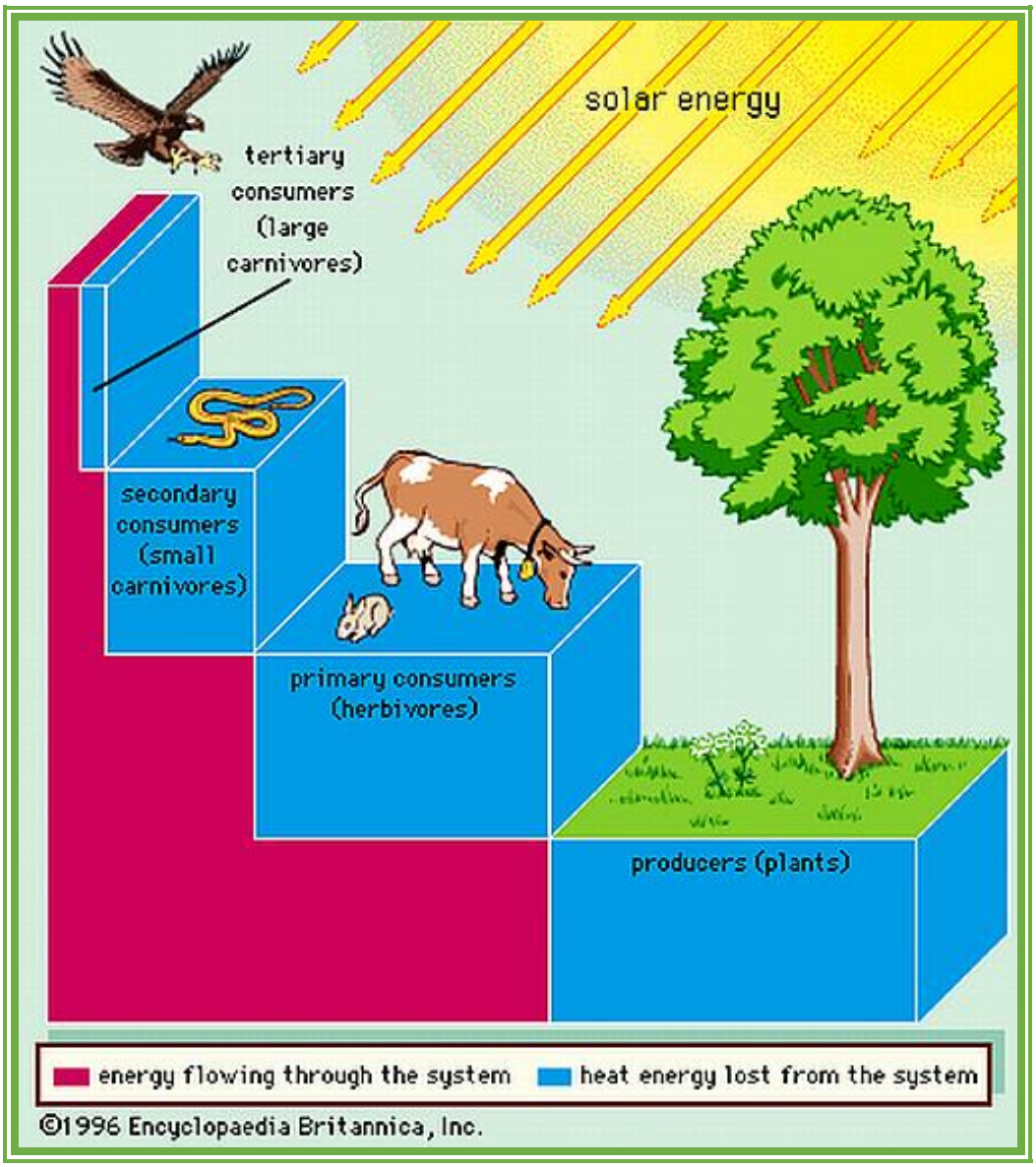
Fig 15.14 in "An Introduction to the World's Oceans" (2nd edition, 2004)




Food Pyramid
3rd Level Consumers
2nd Level Consumers
1st Level Consumers
Producers



Producers and consumers


solar energy
tertiary consumers (large carnivores)
secondary consumers (small carnivores)
primary consumers (herbivores)
producers (plants)
energy flowing through the system
heat energy lost from the system
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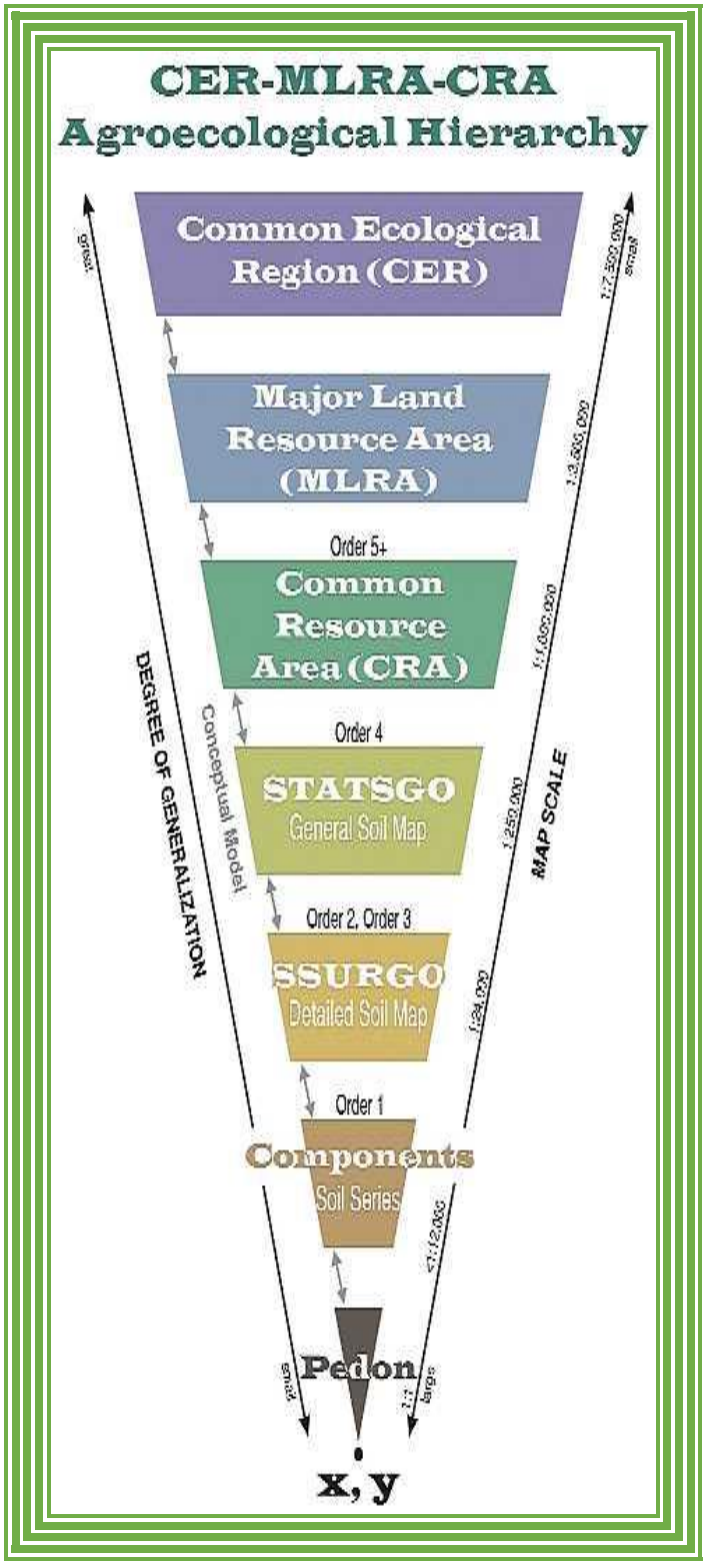
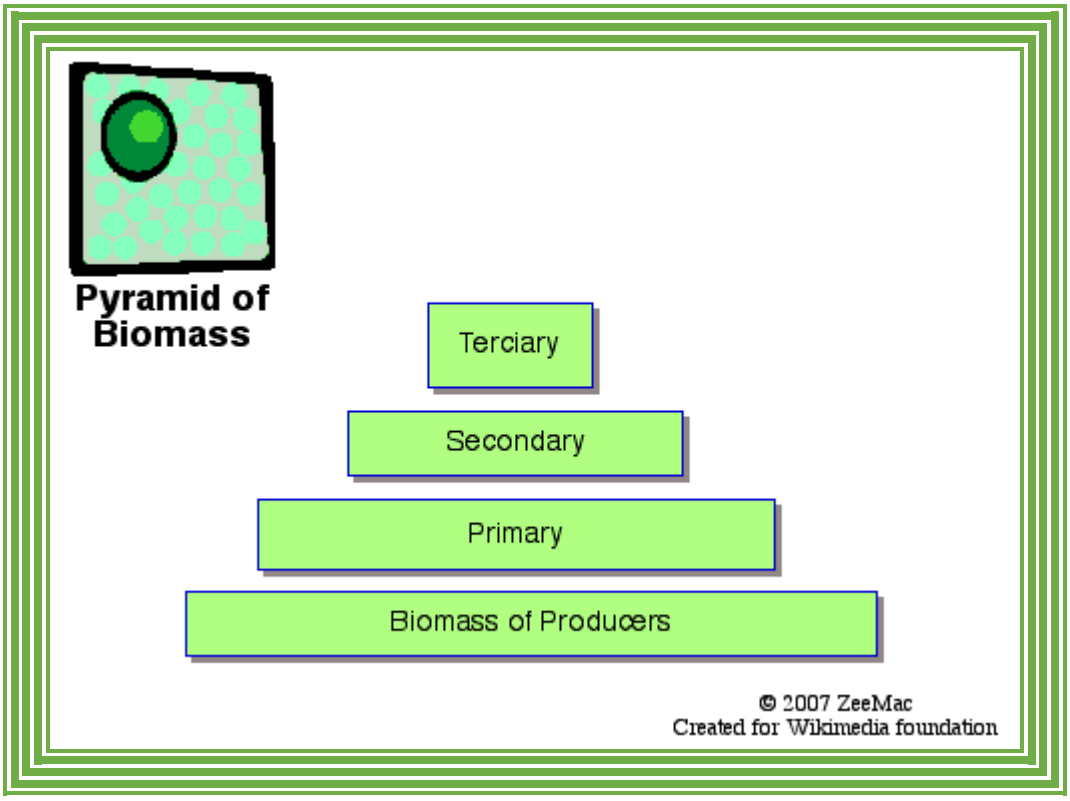
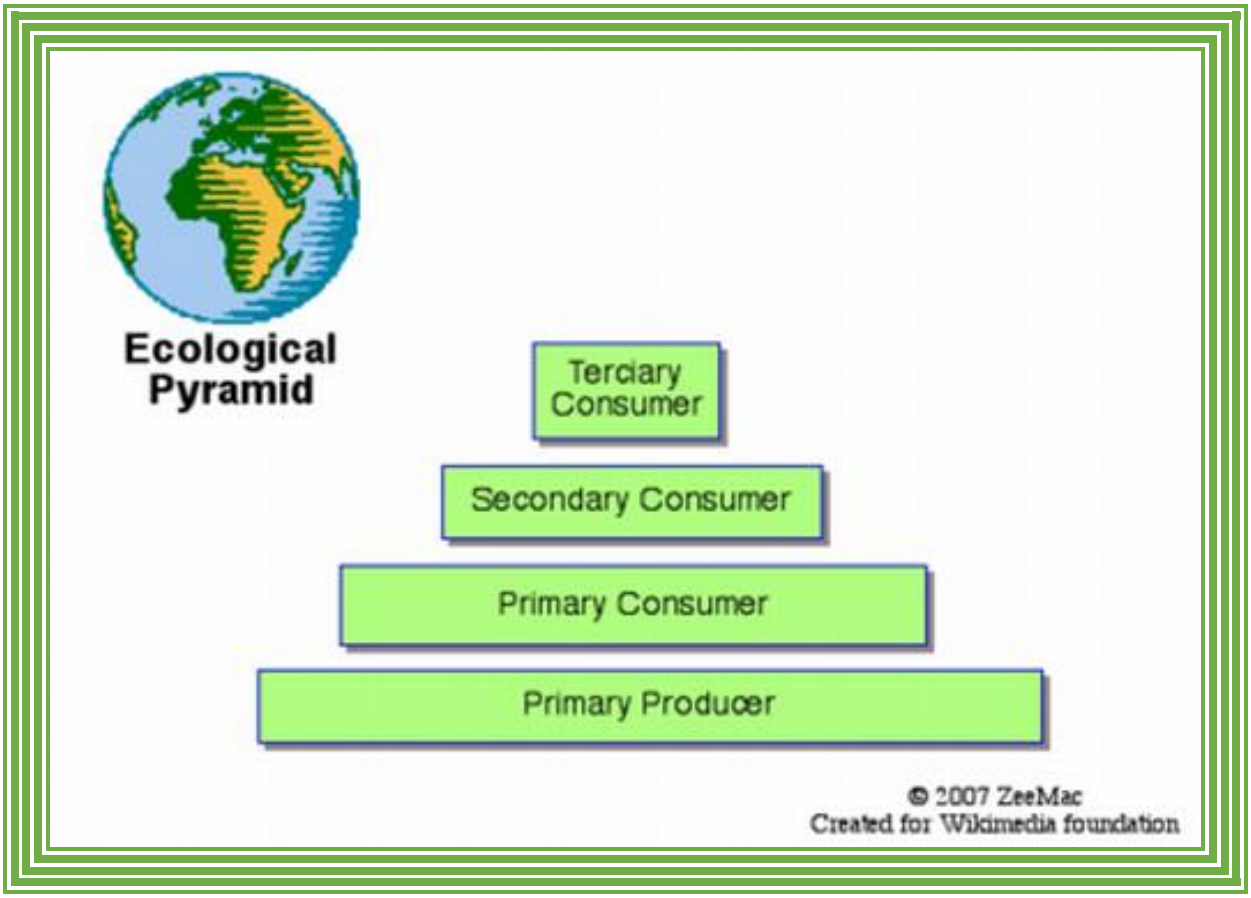
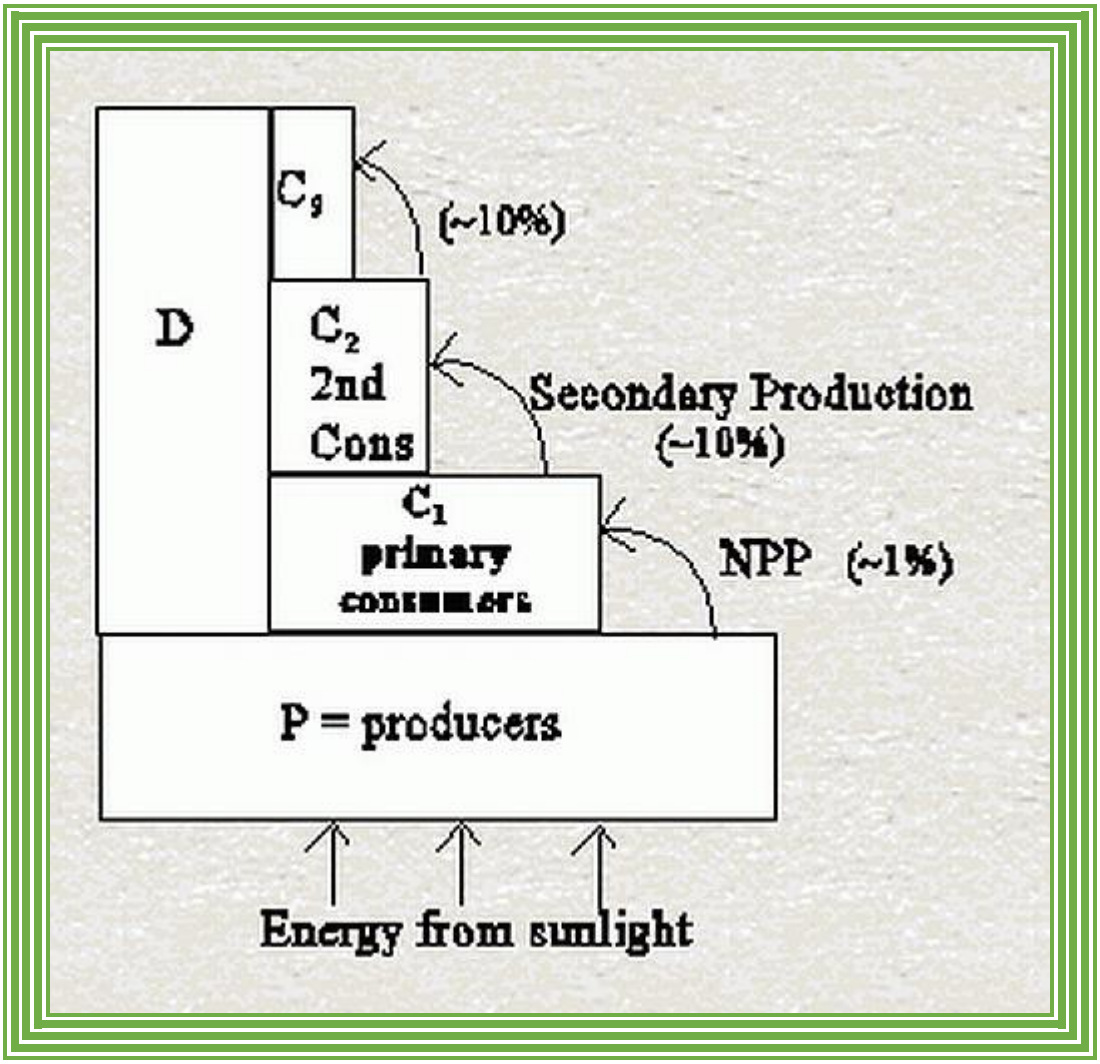

CER-MLRA-CRA
Agroecological Hierarchy
Common Ecological Region (CER)
Major Land Resource Area (MLRA)
Order 5+
Common Resource Area (CRA)
Order 4
STATSGO
General Soil Map
Order 2, Order 3
SSURGO
Detailed Soil Map
Order 1
Components
Soil Series
Pedon
x, y
DEGREE OF GENERALIZATION
MAP SCALE
Conceptual Model
great
small
1:7,500,000
1:2,500,000
1:1,000,000
1:250,000
1:24,000
<1:12,000
small
large



Pyramids of Biomass



The graphic representation of trophic structure in the order of flow of energy from producers to consumers is called Ecological pyramids. They provide qualitative and quantitative information on numbers and biomass; and relationship with each other; so there can be a pyramid of energy, pyramid of number or pyramid of biomass. The most correct representation of an ecological system is by ecological pyramid of biomass. The others are inaccurate. The pyramid of number is also called Estonian pyramid. These can be applied to any ecosystem. The pyramid structure varies from one ecosystem to another ecosystem. Normally these are erect, but only aquatic systems show inverted pyramids.



Eco-Biological Pyramids

Ecological pyramids. They provide qualitative and quantitative information on numbers and biomass; and relationship with each other; so there can be a pyramid of energy, pyramid of number or pyramid of biomass. The most correct representation of an ecological system is by ecological pyramid of biomass. The others are inaccurate. The pyramid of number is also called Estonian pyramid. These can be applied to any ecosystem. The pyramid structure varies from one ecosystem to another ecosystem. Normally these are erect, but only aquatic systems show inverted pyramids.

FOOD CHAINS/FOOD WEBS:

All autotrophic organisms which are capable of synthesizing their own organic materials are called producers. They provide the food and act as the main source of energy for non producers, i.e., consumers. Among the producers there are two kinds, i.e., Primary producers and secondary producers. Similarly, plant eating animals are called as herbivores and they act as primary consumers. Animals which eat other animals act as secondary and tertiary consumers.

Most of the free-floating planktonic algae, epiphytic or lithophytic algae are generally considered primary producers. The terrestrial plants and their epiphytic or semi-parasitic green plants form secondary producers. In any given ecosystem the content and kinds of producers and consumers vary. But all of them exist in an equilibrium state. Such systems are referred to as stabilized ecosystems.

The organization of producers and consumers in a sequential order of flow of energy is called the food chain. It may be linear, branched or inter linked (food web). Most of the ecosystems show food chain in the form of food web.

Linear food chain: Organisms are arranged in the order of ' who eats whom. In all these cases, the starting point is the producer.

Grass -» Grasshopper -» Lizard -» Snakes -» Hawks.

Grass -» Mice -» Snakes -» Hawks

Grass -» Rabbits -» Dogs -» Tigers/Lions.

Trees -» Deer/Goats -» Foxes -» Tigers/Lions.

Trees -» Birds -» Snakes -» Hawks.

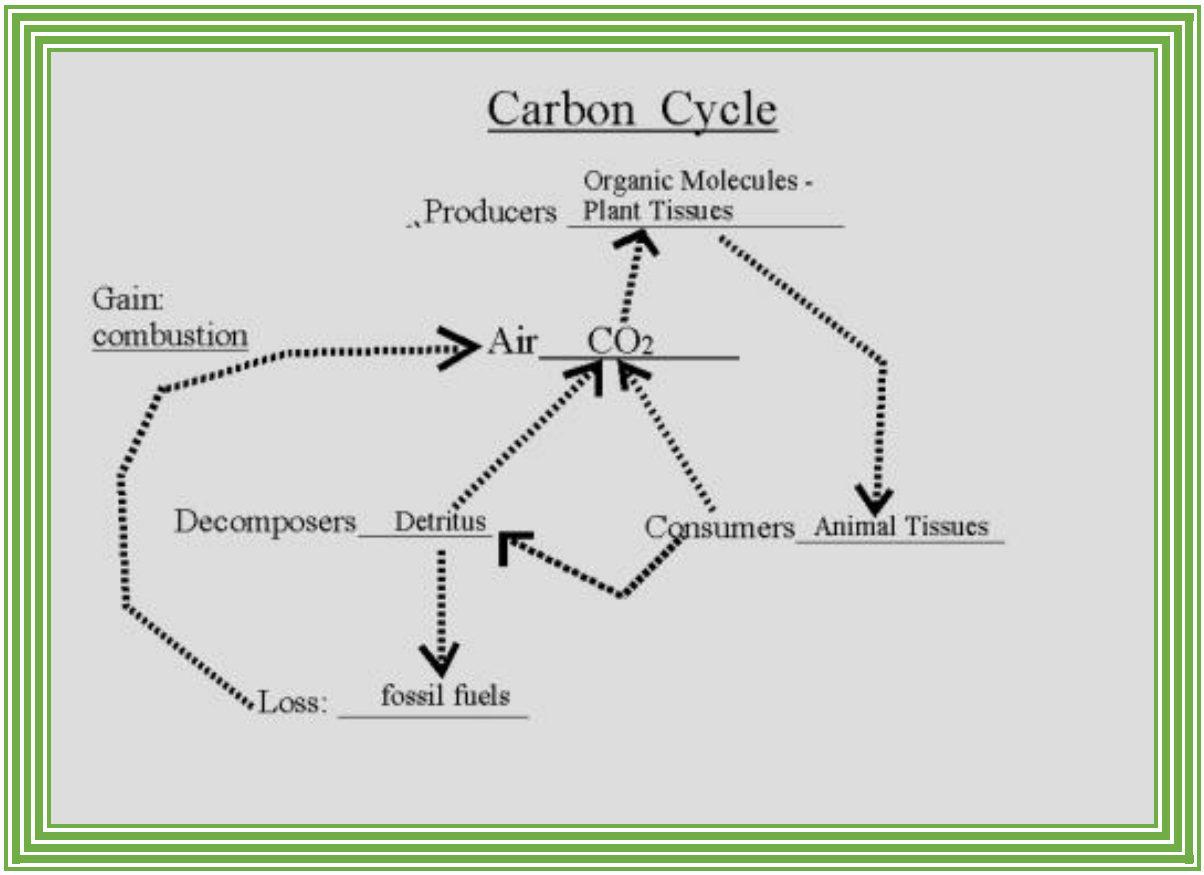
Phytoplankton -» Larvae -» Fishes -» Whales.

Food Web: Grass or its products are eaten by grasshoppers, mice, rabbits, deer, goats, etc. The grasshopper is eaten by lizards or frogs. Frogs are eaten by snakes or hawks. Similarly, mice can be eaten by snakes or foxes. Foxes can be eaten by tigers or lions. The flow of bioenergy in such a system is not linear but interlinked and forms a kind of network called Food web. For that matter, there is no ecosystems with only linear food chain, but all have food web systems.

Detritivores Food Chain: Unlike the above said food chains involving macro-organisms, there are other life forms called microorganisms which play a very important role in any given ecosystem. All dead plants or animals are subjected to organic decomposition by microorganisms. The released organic compounds are further converted to various other simple substances. This process enriches the soil or water. For example, proteins are degraded into amino acids, which are then converted into ammonia. The same can be further converted to nitrates or nitrogen oxides, which can be used by other forms of life. Each one of these steps is controlled by specific microorganisms. Such a series of conversions and converters form the Detritus Food Chain.

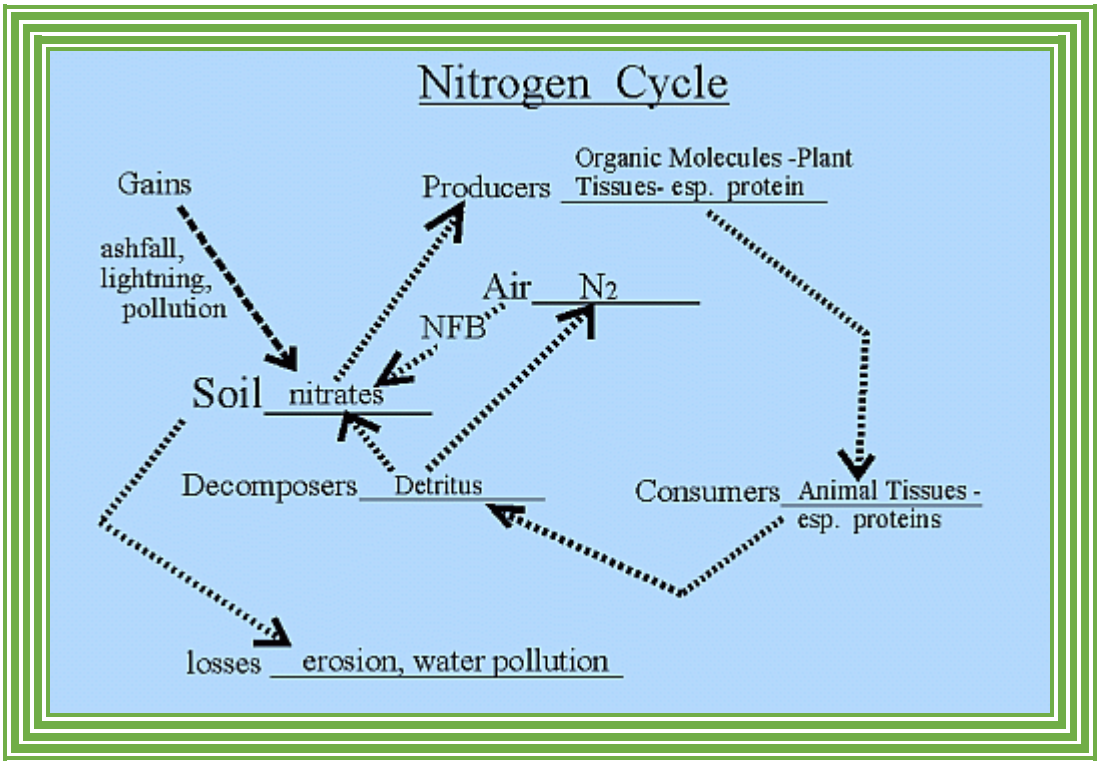
BIO-GEO-CHEMICAL CYCLES:

All ecosystems contain a wide variety of biotic and abiotic components and they exhibit one or the other functions. Using various minerals nutrients, water, C02, nitrogen, light energy, plants build up the organic matter. Continuous use of the above said materials depletes the components from the soil, water and air in course of time.



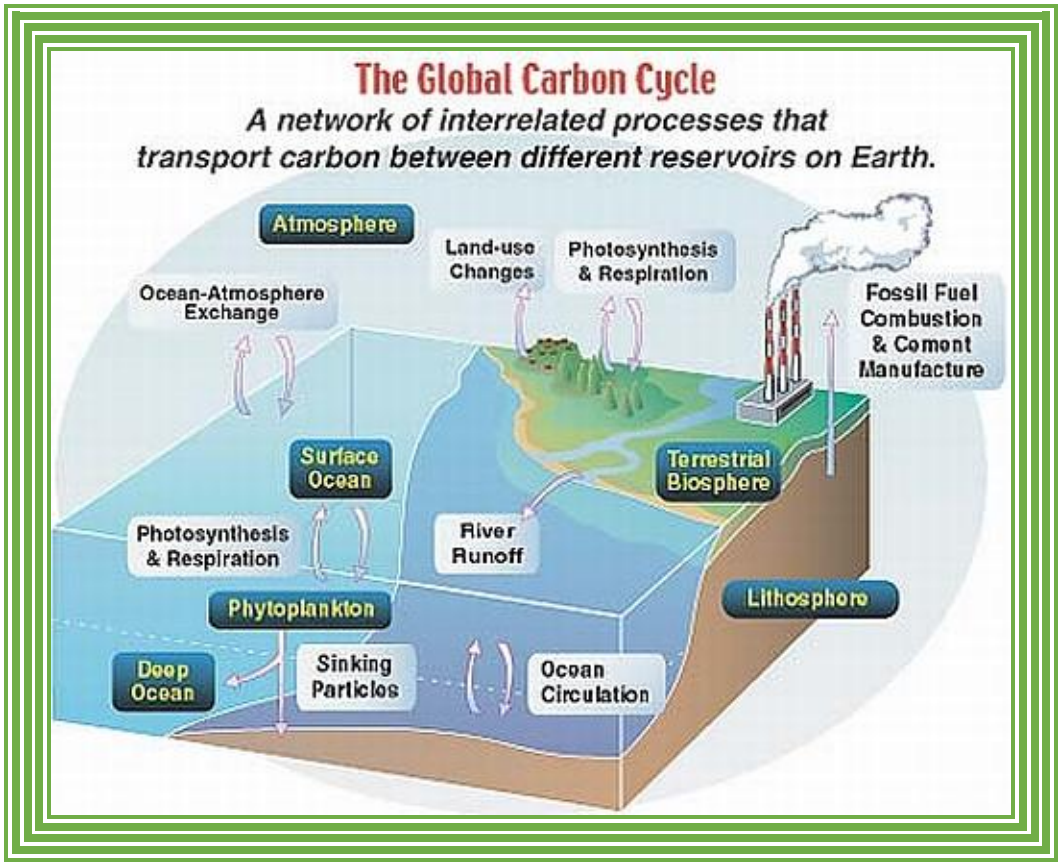
Consumers use the plant products and during oxidation they convert some organic matter into C02 by respiration and also they release ammonia. etc., back to the soil or to the atmosphere. The death and decay of the plants and

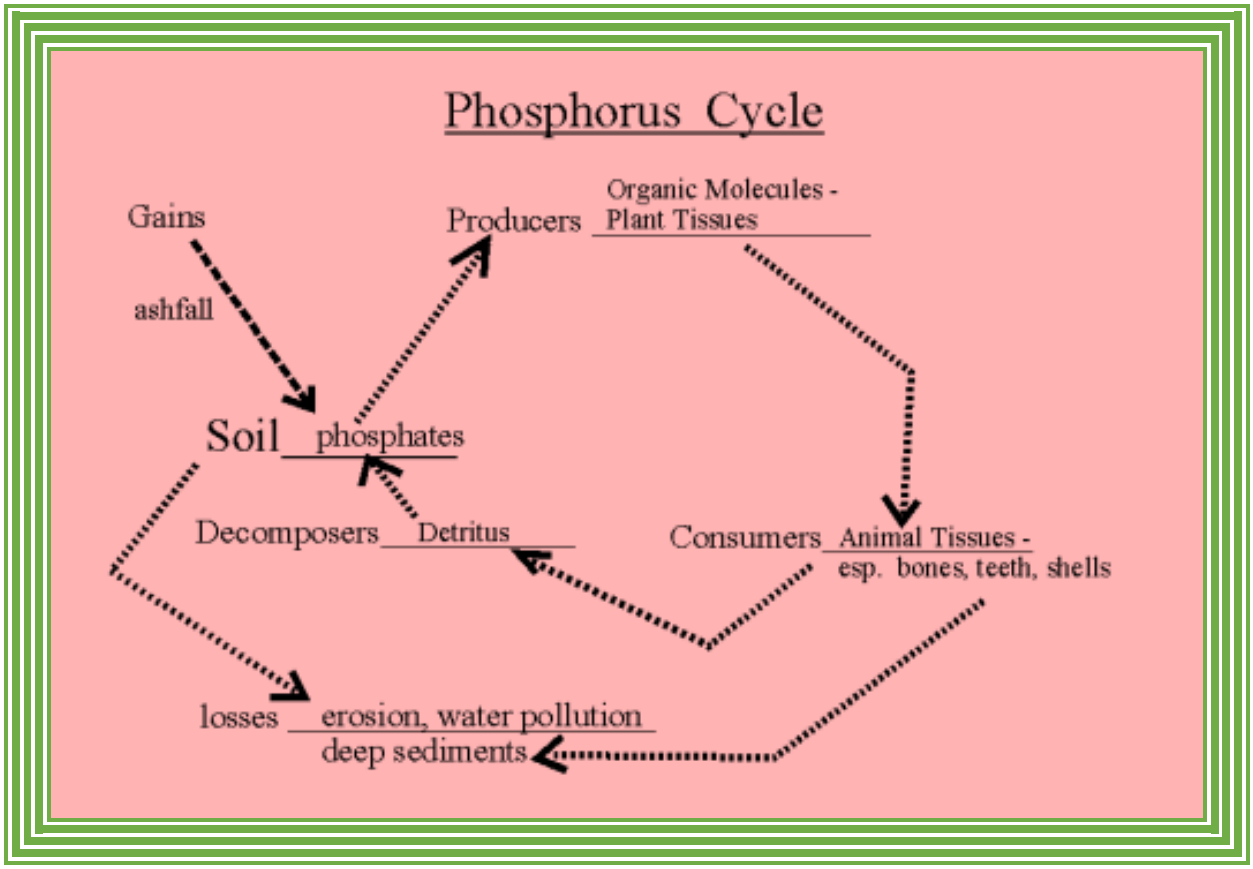
animals also leads to release of nitrogen, phosphorus and other components back to the soil. Thus, they enrich the soil.

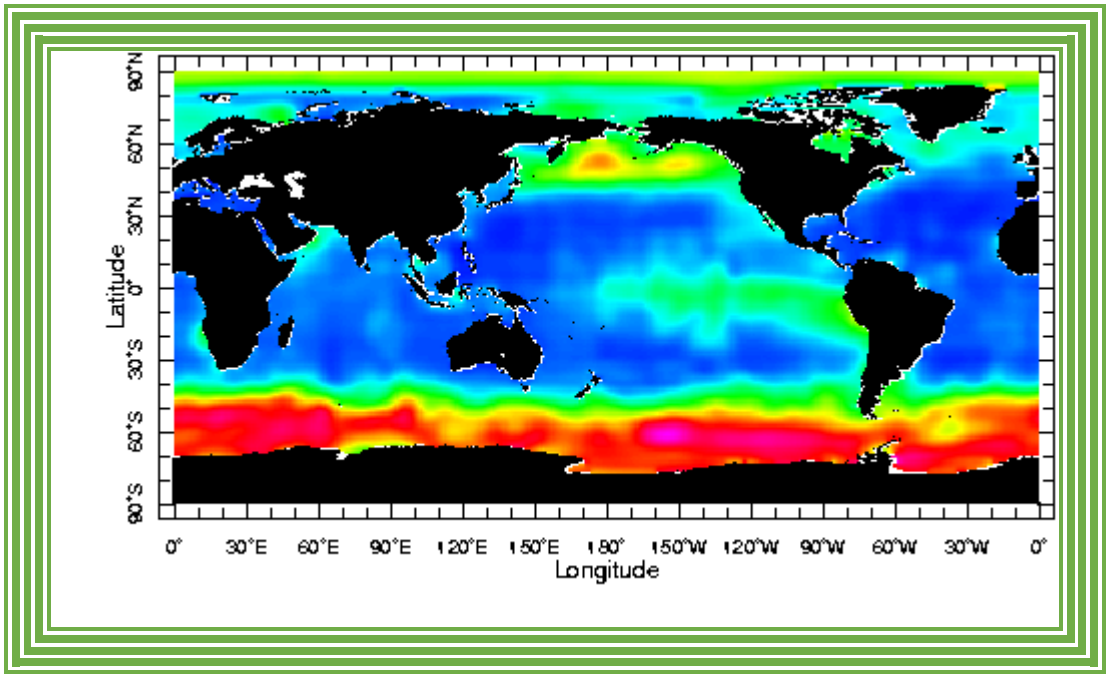


Nitrogen Cycle

This kind of recycling of various abiotic components from soil, water and air into biomass and from biomass back into soil, water and air is called bio-eco chemical cycles. Water cycles, CO2 cycle, Nitrogen cycle, Sulphur cycle, Phosphate cycle are some of the examples of Bio-Geo Chemical cycle.


The Global Carbon Cycle
A network of interrelated processes that transport carbon between different reservoirs on Earth.
Atmosphere
Land-use Changes
Photosynthesis & Respiration
Ocean-Atmosphere Exchange
Fossil Fuel Combustion & Cement Manufacture
Surface Ocean
Terrestrial Biosphere
Photosynthesis & Respiration
River Runoff
Phytoplankton
Lithosphere
Deep Ocean
Sinking Particles
Ocean Circulation


Phosphorus Cycle
Gains
ashfall
Producers
Organic Molecules -
Plant Tissues
Soil
phosphates
Decomposers
Detritus
Consumers
Animal Tissues -
esp. bones, teeth, shells
losses
erosion, water pollution
deep sediments


Latitude
90°N
60°N
30°N
0°
30°S
60°S
90°S
0°
30°E
60°E
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180°
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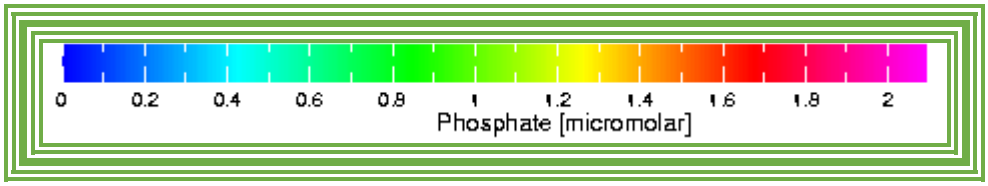
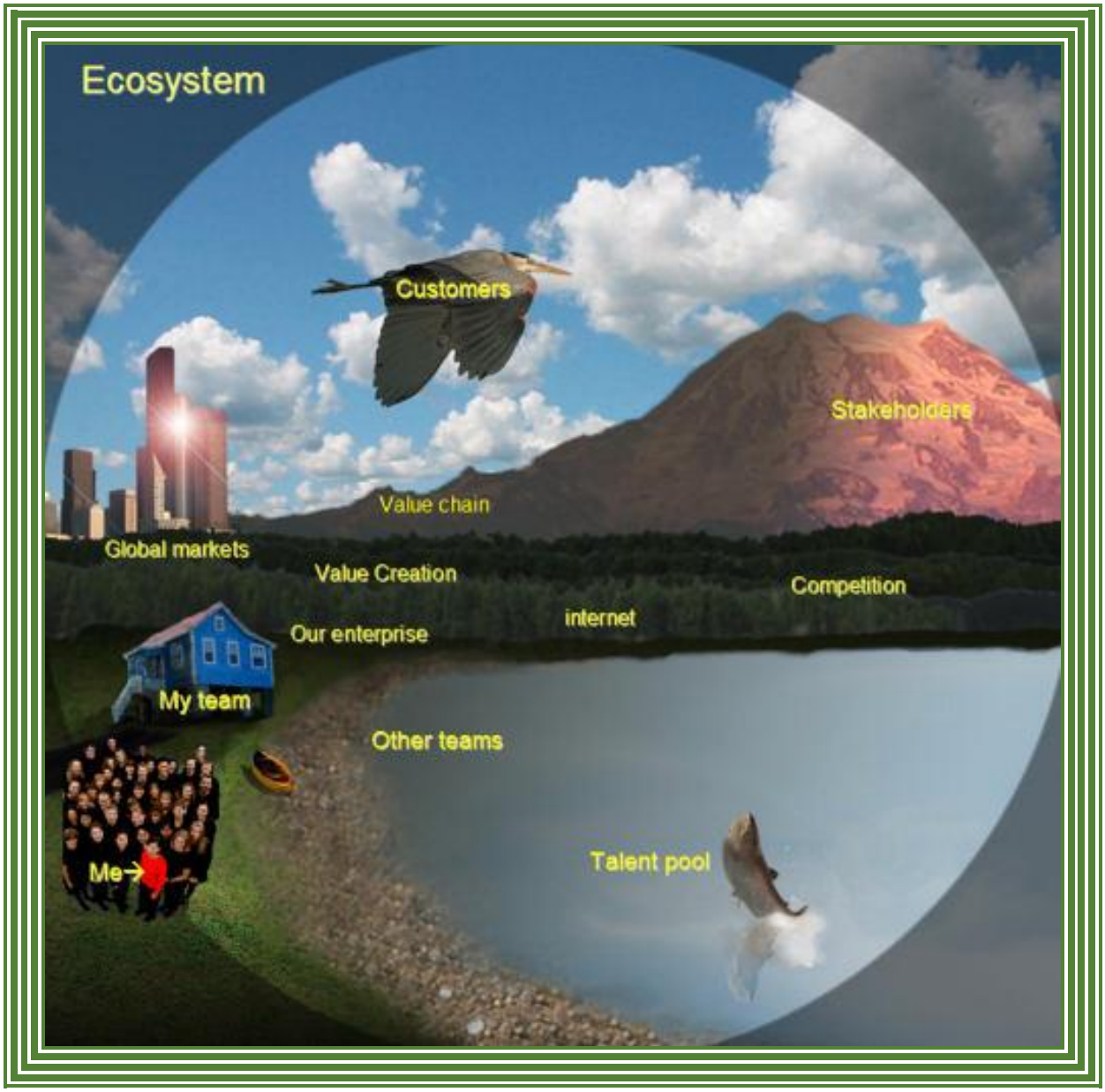
60°W
30°W
0°
Longitude



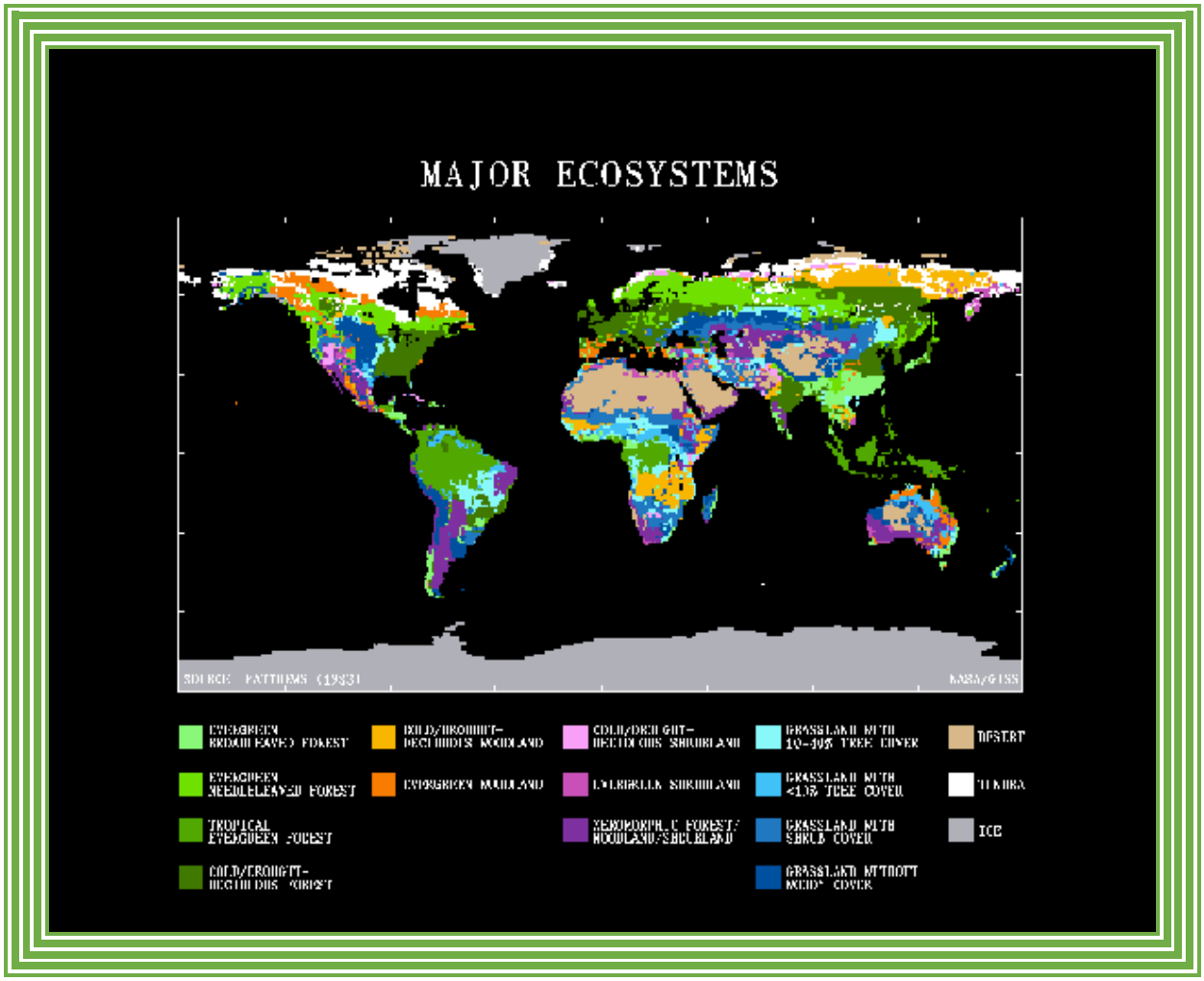
Distribution of Phosphate

MAJOR ECOSYSTEMS

The ecosystem of the earth is very vast and varied. It is difficult to comprehend all the features as unity. We find some area of land covered only with water, in certain areas one finds vast terrains of deserts, forests, shrubs, water-lakes and rocks. Each of these areas has different habitat and different flora and fauna, but they exist in stabilized state. Based on the habitat, flora and fauna, the giant ecosystem is basically divided into Terrestrial ecosystems and Aquatic ecosystems.



Ecosystem in its Entirety



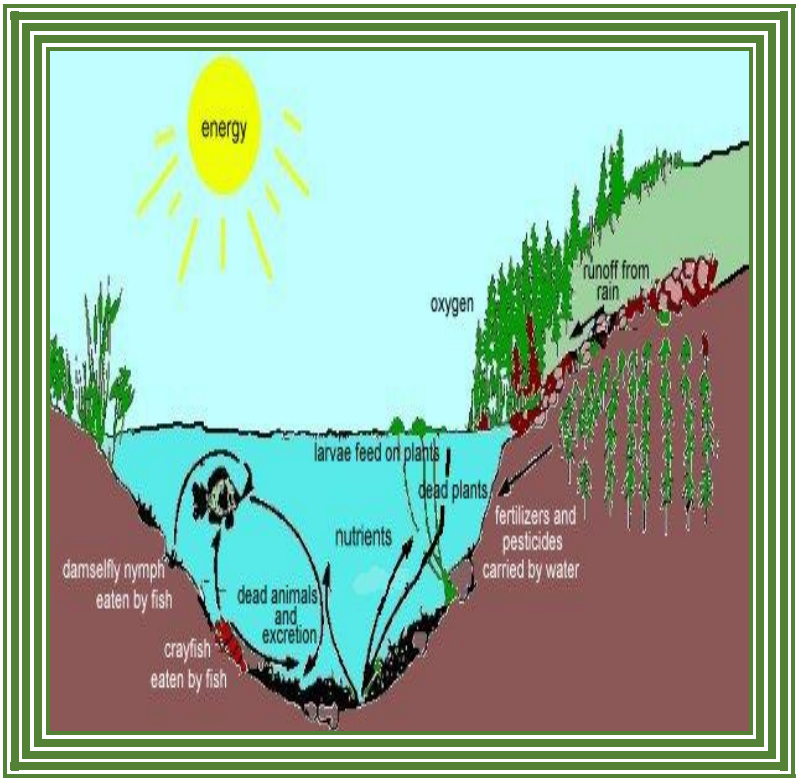
Major Eco-Systems of earth.

Terrestrial ecosystems: Terrestrial ecosystem and its structural and functional contents vary from region to region. A large area dominated by uniform vegetation with other flora and fauna in an equilibrated, but stable state is generally called Biomics. But the term biomes cannot to be applied to aquatic ecosystem because they are considered as higher categories.

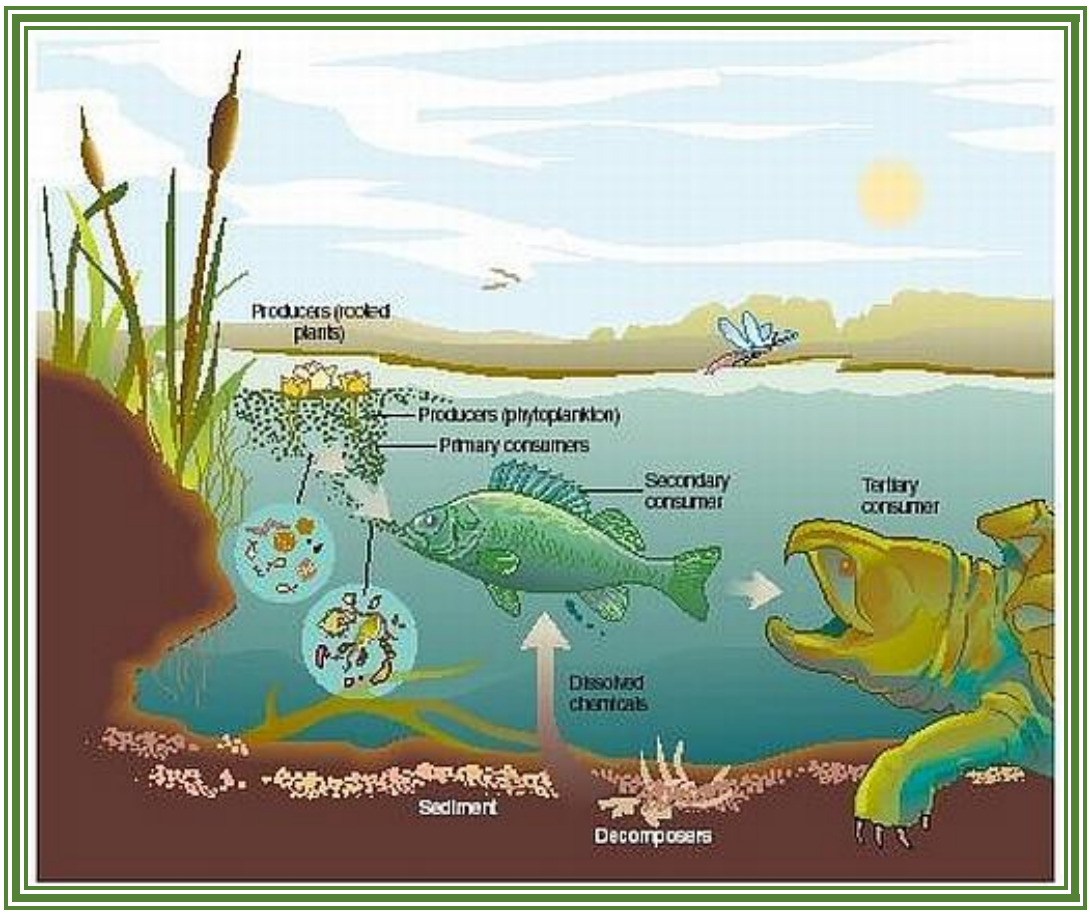
Terrestrial ecosystem is further classified according to their three-dimensional structure of the flora, such as height of the tall trees, number of layers of foliage and horizontal continuity of the foliage layers. The main terrestrial ecosystems are Forest, Woodlands, Shrub land, Grassland, Scrubland & Deserts

Aquatic Ecosystems: Aquatic ecosystem is being the largest of all, occupying 75% of the earth area, and also having a uniform Vegetation over a long period of time, they are considered as higher category than the terrestrial biomes. They are further classified into Fresh water centric, fresh water lotic, Ensturics, Marine benthic and Marine Pelagic etc. Even the communities present in them are grouped as littoral, abyssal etc. In this manual a brief account of few ecosystems has been given.

1. POND ECOSYSTEM: It is a fresh water ecosystem. The half life of such ecosystems ranges from a few hundred years to many thousands of years. Most of them are inland systems whose life span depends upon the area and magnitude. The structural and functional components vary from place to place, altitudes, temperatures, etc. Well established pond ecosystems exhibit a self sustained, self regulated but an evolving assembly.



INLAND SYSTEM



(i) Abiotic Components: The major component is water. Gases like oxygen, C02, NH3, etc., inorganic and organic nutrients and other components are in dissolved state. The pH depends upon the above said components. Water provides the habitat and the environment

(ii) Biotic components:

Producers: They are microphytic phytoplankton and macrophytic rooted plants. The phytoplanktons are floating algae like Volvox, Oscillatoria, Diatoms, Spirogyra, Zygnema, Hydrodictyon, Desmids, etc. The epiphytic ones are Ulothrix, Cladophora, etc. The macrophytes are rooted plants like

Nelumbium, Nymphea, Blixa, Eicchornia, Pistia etc. At the margins of ponds, one finds Cyperaceae and other members of higher angiosperms.

Consumers: Among the primary consumers benthic zooplanktons are very important. Some of the benthic forms are associated with the living plants and some feed on the plant remains at the bottom of the ponds and act as detritus forms. Zooplanktons are Brachiopods, Euglena, Cyclops, etc.; secondary carnivores are insects and small fishes. Large fishes act as tertiary consumers. Microbes found in the pond decay the dead plants and animals, and enrich the pond system with organic and inorganic components. When pond ecosystem is organized into trophic levels, the ecological pyramid of biomass shows an inverted pattern. India has a large number of such natural fresh water ecosystems. Some are man-made. Most of these systems provide raw materials for hydrogenic plant successions.

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2. MARINE ECOSYSTEMS:

More than 70% of the earth's surface is covered with seas. It is a huge mass of water. Indian subcontinent is surrounded by three seas i.e., in the East, South and West Atlantic, Indian and Pacific oceans. Ocean water has more salt and it is denser than any fresh water. The marine ecosystem is one

of the largest and the most stabilized ecosystems. Based on the place and environment these can be subdivided into small groups, because abiotic and biotic components vary from region to region.

Producers: They are mainly Phytoplanktons like diatoms, dinoflagellates and other floating algae. Epiphytic and lithophytic forms like red and brown algae are also found in large populations. Angiosperms are found only on or near the shores. Plants in oceans fix about 135 billion tons of carbon annually.

Consumers: The primary consumers most of the herbivores like crustaceans, mollusks and small fishes. The secondary consumers are hermit crabs, snakes, and markels. Etc. Big fishes, dolphins and whales form the tertiary consumers. Microbes as decomposers are also accounted as important components, for they decompose and enrich the water. Most of the biotic components are unique in the sense; they are structurally and physiologically adapted to salt water. The number and variety of organisms is astounding. In this system also the ecologic pyramid of biomass shows inverted structure.

3. FOREST ECOSYSTEM:

Forest ecosystems cover nearly 25-35% of the total terrestrial or the land area. In India, 1/10 of the land mass is covered with forest ecosystems of different kinds. Forests are considered as the wealth of a country.

Forest ecosystems are further divided into biomes i.e., Tropical Rain Forest, Tropical deciduous forest, Temperate rain forest, Temperate deciduous forests, conifers etc. In India all the above kinds are found. Among the above, tropical rain forests are very rich in soil nutrients and has highest number of species (plant & animal communities) in a given area. Though their location and biotic components vary from each other, they are self maintained systems. Most of the mountain tracts in India have forest ecosystems of one kind or the other. Western ghats and Himalayan ranges are abounded with such ecosystems. Unfortunately, most of the forest systems have gone.

Abiotic components: The abiotic components are soil, water, air, sunlight. Soil is very rich in inorganic and organic nutrients. The microorganisms found in the soil produce lot of organic matter.

Producers: The primary producers are mainly tall trees. There are some shrubs also. Some herbal flora consisting of ferns, mosses, lichens, etc. also dominate the forests. The trees are Tectona, Macaranga, Shorea, Tacoma, etc.

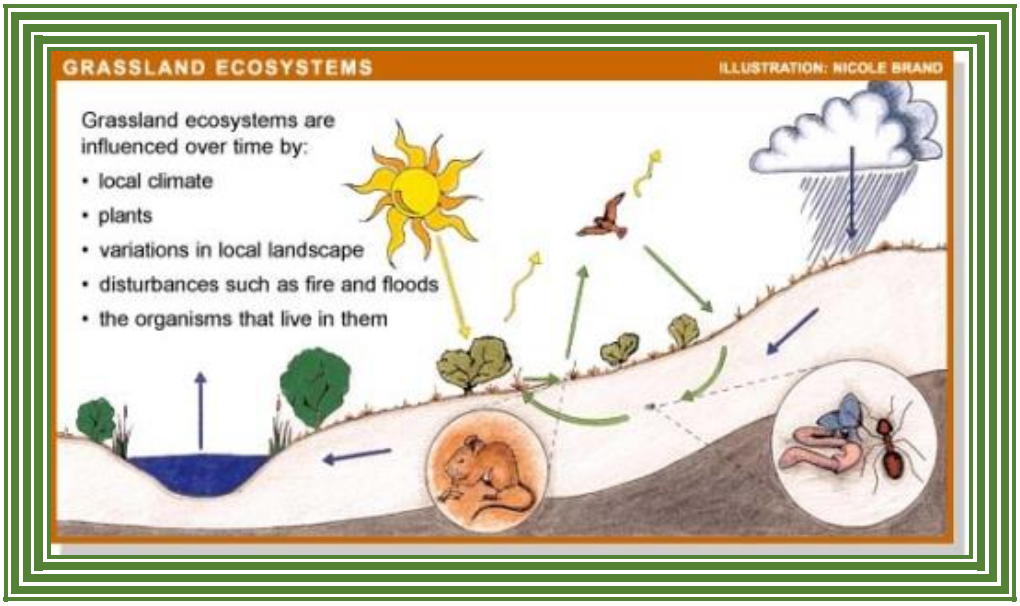
Consumers: The primary consumers are insects, mites, beetles, bugs and ants. Elephants, deer, bisons, goats, sheep also form such community. Secondary consumers are lizards, birds, snakes, foxes, etc. The tertiary forms are lions, tigers and panthers.

4. DESERT ECOSYSTEM:

Nearly 17% of the land mass whose annual rainfall is less than 25cm is a desert. In spite of hostile environmental conditions, certain organisms have established and stabilized in this environment into a self-sustaining ecosystem. The abiotic factors are sandy soil, rocks, high temperature, abundant sunlight, wind, etc. The producers are mostly xerophytic shrubs and herbs; example, canthus, cacti, agave and other succulents. Consumers are mice, birds, camels, snakes, etc. Decomposers also play an important role in a desert ecosystem.

5. GRASSLAND ECOSYSTEM:

Producers: In this kind of terrestrial ecosystem the dominant flora is grass a C4 system. They are the main producers and very efficient than C3 plants. Here and there other shrubs and small trees are present, but they are in minority.



Consumers: The primary consumers are grass eating insects, mice, etc., which are then consumed by the secondary consumers like lizards, snakes, etc. They are then eaten by the tertiary consumers like hawks and eagles. The microbes found in the soil also contribute to the ecosystem by enriching the soil with organic matter. It is important to remember that the producers dominate the flora and fauna many thousand times over. And they are the most efficient producers in terms of capturing energy and fixing carbon into energy rich organic matter. Such an ecosystem has climatic vegetation.

ENVIRONMENTAL PROBLEMS

All organisms, capable of breeding, multiply in course of time and increase in their number in mathematical ratios. According to Charles Darwin, over production, leads to struggle for existence i.e., for shelter, food, reproduction etc. The survival of the fittest leads to the origin of species. It is a natural process. That is how evolution progresses.

Human Population explosion: Human population is not an exception to Malthusian law of nature, but he is a self-centered species. Today the world's human population is more than six billion. Sadly, India and China together have contributed more than 2.8 billion to it. The population explosion has endangered the very existence human species. But it also affecting the other species. In fact, the growth rate of human population in exponential pattern started with agricultural revolution and it is still

progressing in the same rate though the overall birth rate has remained at 1.7-1.9, percent but the death rate has drastically decreased. By 2023 the world's population is expected to be more than 7 billion.

The damage caused by the population explosion and industrial revolution are many, all of them are self destructive: - they are deforestation, environmental pollution etc. In fact, all the ecological and environmental problems that the planet earth is experiencing, is mainly due to uncontrolled growth of human population.

Deforestation & its effects: Forest wealth has been exploited for human needs like shelter, agriculture, transport, fuel etc. What is left today is not even enough for another 3 decades, provided afforestation is taken up on large scale. Massive cutting of trees in Asia and Brazil's Amazonian virgin forest for commercial exploitation and burning of forests for cultivation is going on unabated. At this rate of destruction i.e., 100 acres per minute, goes on, by 2020 all forests will be destroyed. Not only cutting of trees, even mining has destroyed the vegetation, fauna and even the ecosystems.

Deforestation has upset the balance of the very ecosystem. When producers are destroyed, the dependent animals and their dependents migrate. In the process many of them die.

Deforestation has caused considerable damage to the soil in the form of soil erosion, land slides, and flash floods, loss of minerals and organic matter. All have rendered the soil useless for the growth of flora and fauna.

With the disappearance of vegetation, the moisture content of the soil and atmosphere has reduced. As a consequence, the annual rain fall has also decreased. All these effects have led or leading to desertification of the land mass.

Industrial revolution and its effects:

Population explosion has also resulted in the growth of a large number of cities and towns. Another parallel development is the growth of industries. It is the product of human ingenuity. The uncontrolled growth of industries, in cities and towns has caused greater damage to the environment than any other single factor.

1. Overcrowding & growth of urban centers:

Overcrowding of cities and towns has resulted in the development of large number of slums, accumulation garbage, and inundation of large tracks with sewerage water in all conceivable places. Such unhygienic conditions arc threatening millions of people with waterborne, airborne communicable diseases: some of them are of epidemic in nature. A simple mutation in any one of the harmless viruses can result into a virulent variety which can wipe out the entire human population before he could realize what has hit him. Such pollutions have also devastating effect on the flora and fauna of the area.

2. Eutrophication:

Human waste and other animal systems in the form of organic waste (N_2), from overly populated areas, entering into large tracts of water body has noxious affect on aquatic ecosystem in the form of cultural Eutrophication.

Similarly soil erosion also causes the down flow of many minerals especially phosphate into large body of water. The entry of organic N_2 & phosphate etc and other nutrients causes great bloom & luxuriant growth of the floating vegetation. As a consequence, the lower lying flora, because of lack of sun light, dies. The detritious forms, utilizing oxygen degrade the dead plants. As a result, deoxygenating of water takes place. Many zooplanktons die. This phenomenon is called Eutrophication, which causes greater damage to the said ecosystem.

3. Land & water pollution:

Added to this, industries are spewing out all kinds of obnoxious and poisonous gases into air and discharging waste. Industries are producing more wastes than products. All their waste is dumped either on land or in water. Rivers have been polluted by industrial discharges to such an extent, most of the fresh water forms are either dead or dying. Drinking water for animals is not available for miles. The lands have become uncultivable.

4. Air pollution & Acid rain:

Iron and steel industries & oil refineries & others all over the world are spewing out great amount of CO_2 and other gases, industries which arc using carbon as the fuel are darkening the skies with CO_2 and carbon monoxide & carbon dust The motionless dark clouds called smog (smoke & fog) hanging the over populated area, bring down the CO_2 or phosphorous oxide and SO2 or all in the form of acid rain which has already destroyed many million hectares of million years old rain forests and severely affected the health of millions of animals including human being.

5. Oil spillage:

Oil spillage on land and sea is again destroying a large number of flora & fauna. In recent years oil spillage has become a common phenomenon. The above said pollutants have not only affected human beings but alto devastating all kinds of ecosystems.

6. Green house effect:

The burning of high grade fossil fuel by motor vehicles, dieselized engines, coal based power stations, fertilizer industries, high speed jets etc are polluting the very air we breath with CO, CO_2, NO_2, benzpyrine and other deadly gases.

Industrial output of CO_2 and pollutants and large scale burning of forests and the release of heavy amount of CO_2 is of great concern to the civilized world. Increase in the concentration of CO, CO_2 and other gases is believed to have a devastating green house effect The dense cloud of CO_2 and similar materials forming a mantle over the earth, though allow the sun rays to reach the earth's surface, the long wave length infra red rays or far-red rays, radiated back to space are again reflected back to earth, by the clouds causing global warming by 1.5°C to 4.5^{0}C. Such global warming results in the melting of a large body of ice collected at the polar caps. This may entail in raising the water level of seven seas, and many cities, towns, located at the shore will be inundated or completely submerged. But to check this devastating consumerism one has to devise alternate technology and make it available to common man, till then one cannot simply say no and put blanket

cap to the developing nations and underdeveloped nation who are on the verge of growing, will have greater impact on the national growth. The developed countries won't be affected, because they can take it.

It is also important to evaluate, whether or not the burning off the fuel by human beings is the lone cause for global warming? The sun of our solar system has passed its half age and it is burning fast with more solar bursts and eruptions which is happening day in and day out. Calculation of solar burning has thousand times more effect on human consumerism. How do you control. People shout that that CO2 among other gases is the main factor that causes global warming; it is not a correct argument. The green plants on this planet whatever left requires more concentration of CO2 for, increase in the concentration from 0.03% to 100 times or more, plants produce more biomass, than what they are doing now. At this point of time the concentration of CO2 in the atmosphere is not enough for full blown photosynthesis till eleven or twelve O'clock in the morning, and the whole day they will be releasing CO2 via photorespiration respiration. Also we have to remember plants in dark are releasing more CO2 than any other systems. So what do you call CO2 is and evil or savior of ecosystem? Living beings also producing and releasing organic gases which have devastating effect on our environment. Until and unless, some cacophony self claimed environmentalists, found in every nook and corner, understand what is what, the real scientists who know the science of global warming, will remain silent spectators. We never understand the CO2 is held by oceanic water, god bless the ecosystem there free of the abuse.

7. Nuclear pollution:

Nuclear wastes in form of used radioactive isotopes are dumped in all unimaginable areas of land and water. In some places they have been washed into drains to join sewage water. Nuclear power stations, one time or the other, due to malfunctions of machines or human beings, spew out vast amount of radiation. Classic examples of Three Mile Island in USA and Chernobyl disaster is USSR have caused irreparable damage to surrounding communities. The piled up nuclear arsenals in the developed world like USA & USSR, even if 1/10 of it is used in any war, or exploded by an accident can, not only devastate the whole area covering 2000 to 5000 square miles and also cause the most dreaded 'Nuclear Winter

8. Holes in Ozone mantle:

The burning of fuel also releases nitrogen oxides (NO) along with carbon gases, which when react with ozone; the ozone will be destroyed to oxygen.

$NO+O_3 \gg\gg NO_2 + O_2$

Another class of compounds which are used in refrigeration on large scale is Chloro-fluro carbons. On release they interact with ozone, and the ozone layer will be destroyed. From outer space, through satellites, holes in ozone layers in polar regions have been detected. Ozone layer, around the earth is virtually shielding all living organisms on this planet from ultraviolet (UV) radiations emanated from the sun. The ozone layer all these millions of years has absorbed the UV rays and prevented them reaching the surface of the earth. If the ozone layer is destroyed, UV radiation can cause mutations in

all living organisms. It is an unimaginable scenario of devastation & destruction when it happens. Fortunately, human intervention has now brought back the ozone safety.

9. Biocides:

Modem agricultural methods of cultivation have brought in many benefits to the mankind. But the excessive uses of fertilizers, fungicides and insecticides have polluted the very land where the crop plants are grown. The residuals left in the soil and plant products are not only destroying the micro flora in the soil but also threatening the animal and human beings with all kind of diseases with no cure in sight due to seepage of contaminated water the very water we drink is heavily contaminated.

10. Hydroelectric & Irrigation projects:

Big hydroelectric and irrigation projects are the life lines for the progress of any country. But the backwaters of such dams have submerged vast track of land and destroyed well established ecosystems. In the down stream water logging and salinity have rendered croplands into waste lands.

The overall effect of population explosion on environment is deadly and devastating. Another greatest tragedy, as an offshoot of population explosion, is an increase in illiterate population among the poor as well as an increase in the illiteracy among the literates, about environment &

environmental hazards. It looks like, it is beyond the human ingenuity to reclaim and reuse what has been already destroyed and damaged.

MEASURES TO CONSERVE ECOSYSTEMS AND THE ENVIRONMENT

1. Control of population growth: In order to save ecosystem and him and other life forms from human abuse, first man has to check the growth of his own population to a limit before it grows into an uncontrollable "Human time Bomb". Family planning has to be enforced irrespective of cast or creed.

2. Control the growth of cities & towns: Growth of already over crowded big cities and towns have to be checked from growing still bigger, which is inevitable. The residents should be provided with proper shelter, water, drainage and sanitary facilities.

3. Convert garbage to wealth: Sewerage and garbage have to be properly disposed or collected for reprocessing and reuse. Garbage is not a waste but it can be converted into wealth, if it is properly done.

4. Decentralize industrial centers: At the same time, over crowding of cities and towns with more industries should be halted to check the mass migration of rural population to urban areas. Only sensible Govt. can do it for it is the problem of the nation; in its larger sense it is the problem of the world.

5. Control of pollution: Air pollution, water pollution, soil pollution by hazardous outputs from industries, gasoline burning by motor vehicle, jets & thermal plants, should be controlled by proper

Corrective measures in the form of enforceable laws and honest authorities. Those, who fail to obey the laws, should be severely punished.

6. Purification of Air, water, and Land: Hazardous industries including nuclear plants should be shifted far away from human habitation. All corrective and preventive measures should be undertaken from any kind of miss happenings. Methods to depollute the air, water and land have to be devised by new and innovative technology of 21st century.

7. Reclamation of lands: Saline, water logged and dissertated lands have to be reclaimed for cultivation by innovative technology.

8. Use of Biotechnology: Including genetic engineering, Biotechnology should be used to grow more food in less area. Instead of using degradable or not degradable pesticides or insecticides or fungicides etc, one has to develop new varieties resistant to pests and pathogens, but at the same time they should be high yielding. The frontier technologies in life sciences have to be innovated and applied with war footing. Environmental pollution can be contained by using bioengineering techniques.

9. Afforestation: Soil erosion should be prevented by using recent biological & mechanical methods at any cost Afforestation in all conceivable

areas should be undertaken on a massive scale. Social forestry should be encouraged at village level as well as at global level. This has to be done, by consensus environmentalists by educating the public as well as the notorious politicians in power.

10. Mass Education on Environmental problem: Education in this regard, on a large scale in relevant areas and to relevant people is essential. It is essential or imperative to develop infrastructure and technology for educating the mass at rural, semi urban and urban level in Ecology/environmental hazards and of methods that can save the Ecological wealth and to improve the environment Inculcating the knowledge and methods to conserve environment at the level of school children and illiterate mass is more beneficial than educating the so called educated in urban areas.

CONTROVERSY OVER PROGRESS AND CONSERVATION

Progress of a country is measured in terms of its total economics of food production, industrial output, living standards, quality of education, economic viability etc. This depends upon how much of natural wealth is used as the input for the above outputs. Protagonists of exploitation of natural wealth for the progress of the country are one breed of extremists. They are so greedy; they are not satisfied even if one hands over the entire wealth of a country at their disposal. They are the men who have plundered the natural wealth and exploited the human resources in the name of progress.

Unfortunately these monsters control Govt. and its administration with remote controls.

There is another group of people, Khadi clad or Kaavi clad with red or green head gears, who call themselves as environmentalists. Greens conversationalists, a "new breed" indeed. Day in and day out, they scream through microphones on big and colorful platforms, "stop cutting trees", "stop constructing dams" etc. Their patriotism sores to great heights and their intelligence overflows, over a bottle of concoctions. While these people talks big about environment, their household people throw garbage on to streets, spit on the footpath and litter the road and parks with all kinds of things and still blame the Govt. These are the other kind of extremists who make others to believe that talking is progress, obstructing the developmental projects is progress, shouting for political gains is progress. There are some exceptions where people have done good work in this field.

The saner, the pragmatic experts in ecology and environmental sciences and really progressive people believe that progress of the country is not possible without the use of natural wealth. But they want to find ways and means to reuse what has been already thrown away as garbage and urge not to destroy, nor use what is not needed; don't waste.

Checking the growth of human population is the most important measure to be undertaken with war footing. Without such programs no progress can be made in any place or any time. Over population is the scourge of our society. It outgrows itself into self destructing time bomb. The so-called

environmentalists in India, if they have any concern above the conservation of Environment, first they should start campaigning for birth control at all levels of the society to bring down growth rate of human population in India and all over the world.

Industries are required for the progress of the nation but measures have to be taken to prevent wasting the natural wealth and measures to prevent pollution of environment. Precaution and safety methods have to be employed to prevent accidents like Bhopal, Three Mile Island, or Chernobyol.

Afforestation has to be done with great forethought its effect may not be perceived today, but can be felt after fifty or hundred years from now. Reusing of the so-called waste has to be done in large scale to prevent further exploitation of the environment. When there are no immediate alternatives, one has to use what is available.

It is true that the backwaters of huge dams meant for irrigation and electricity do damage the local flora and fauna. At the same time one should remember that any storage of water is also the starting point for another series ecological succession resulting in an ecosystem. So there is no need to stop the very lifeline of progress.

Conservation studies on protected ecosystems of islands have given few clues how the same methods can be employed on main lands. Govt. laws have to be made and implemented by declaring vast tracts of ecosystems as protected areas in different regions. It is no good to declare inconsequential

and small areas as protected. Large areas, having greater number of species of flora & fauna in a given unit area establish themselves to the said ecosystem. Law enforcements should be strict to prevent poaching & deforestation.

Well laid planning has to go into the conservation of ecosystem. No society can survive or progress without the utilizations of forest products. But if plans are, made with future in mind, so that, while cutting of 10 hectares of plantation, there should be 50 hectares of plantation ready and equal area should be afforested. This kind of planning entails in not only conserving the ecosystem but also enriches it.

One should bear in mind that progress is not just accumulation of money and material etc, nor can you call yourself progressive just by stopping the cutting of trees, digging minerals from the mines, stopping the construction of huge dams and industrial plants; the real progress should be in human thinking; and it emanates from education and educating. Progress can be achieved when you acquire what is needed and sharing the extra with have-nots. The sharing may be money or material, but sharing the human thought and knowledge is the greatest progress that any man or a country can dream about

An Experiment to determine the Relative density of plant species:

Method: This experiment is conducted in groups. Take the help of teacher in selecting the area and identifying the plant species. Select an area

measuring 10 x 10 feet or 20 feet and mark with nails and thread. Count the total number of plants and count the number of each species and note down. Using the given formula calculate the relative density of each species and plot the same on a graph sheet showing the distribution area wise with table. If you find time you can conduct such survey in two or three different plots in different areas containing different flora.