4. INTRODUCTION TO ECOSYSTEM AND ENVIRONMENT

1 Ecosystem: Concept and Definition

An **ecosystem** is a biological environment consisting of all the living organisms or biotic component, in a particular area, and the nonliving, or abiotic component, with which the organisms interact, such as air, soil, water and sunlight.

The entire array of organisms inhabiting a particular ecosystem is called a community. In a typical ecosystem, plants and other photosynthetic organisms are the producers that provide the food. Ecosystems can be permanent or temporary. Ecosystems are functional units consisting of living things in a given area, non-living chemical and physical factors of their environment, linked together through nutrient cycle and energy flow.

Ecology

Ecology is the interdisciplinary scientific study of the distribution and abundance of organisms and their interactions with their environment. The environment of an organism includes all external factors, including abiotic ones such as climate and geology, and biotic factors, including members of the same species and other species that share a habitat .

Examples of objects of ecological study include: Population processes, including reproductive behavior, mortality, bioenergetics and migrations, interspecific interactions such as predation (relationship between two groups of animals in which one species hunts, kills, and eats the other), competition, parasitism and mutualism, plant and animal community structures and their function and resilience, and biogeochemical cycling. Because of its vast scope, ecological science is often closely related to other disciplines .

Aside from pure scientific inquiry, ecology is also a highly applied science. Much of natural resource management, such as forestry, fisheries, wildlife management and habitat conservation is directly related to ecological sciences and many problems in agriculture, urban development and public health are informed by ecological considerations .

The term "ecology" has also been appropriated for philosophical ideologies like social ecology and deep ecology and is sometimes used as a synonym for the natural environment or environmentalism. Likewise "ecological" is often taken in the sense of environmentally friendly.

Elements of Environment and Ecology

The "five basic elements" already recognized at the origin of most cultures can best be described in contemporary scientific terms, as the "basic environmental elements". It is precisely because they are environmental elements that they have been observed and considered of great importance by all men in all cultures in one form or another. Life and death are the main concerns of thinking man and one may venture to imagine what the mind would perceive as the basis of this unexplainable phenomenon that is life. Man would see:

EARTH

The solid matter from which comes all food directly or indirectly; all materials for shelter, clothing and utensils. Hence earth or soil and rocks are usually called Mother, or the one who feeds and carries her children before and after birth, while alive and after death.

WATER

The liquid matter for drinking, indispensable to preserve life but necessary also as a cleansing agent, for cooking and for extracting substances from solid matter. Earth and Water are closely related.

AIR

The gaseous matter necessary for respiration and combustion and for the production of light; earth, water, air are the indissoluble trio without which there is no life.

FIRE

The transformer of matter into non-matter, is the heat or energy that keeps everything, living and non-living always on the move.

ETHER or *AKASA*

Aakas or Non-matter or void is the imponderable, unexplainable, indescribable aspect of nature that pervades everything. Everything has an opposite and *akasa* is the opposite of matter.

2. Food Chain

The transfer of food energy from producers, through a series of organisms such as herbivores to carnivores, from carnivores to decomposers, with repeated eating and being eaten, in a linear form is known as the food chain.

Producers utilize the radiant energy of the sun, which is transformed into chemical form, ATP (Adenosine in- phosphate) during photo synthesis. Thus green plants occupy, in any food chain, the first trophic (nutritional) level. They are the producers so are called ***Primary Producers***. The energy stored in food matter manufactured by green plants is then utilized by the plant eaters, the herbivores. Herbivores constitute second trophic level, and are called the ***Primary Consumers***. Herbivores, in turn, are eaten by the carnivores, which constitute the third trophic level, the ***Secondary Consumer*** level. These in turn may be eaten by other carnivores at tertiary consumers level, so they are called the ***Tertiary Consumers***. This simple chain of eating and being eaten away is known as the ***food chain***.

Food Chain in a grass land

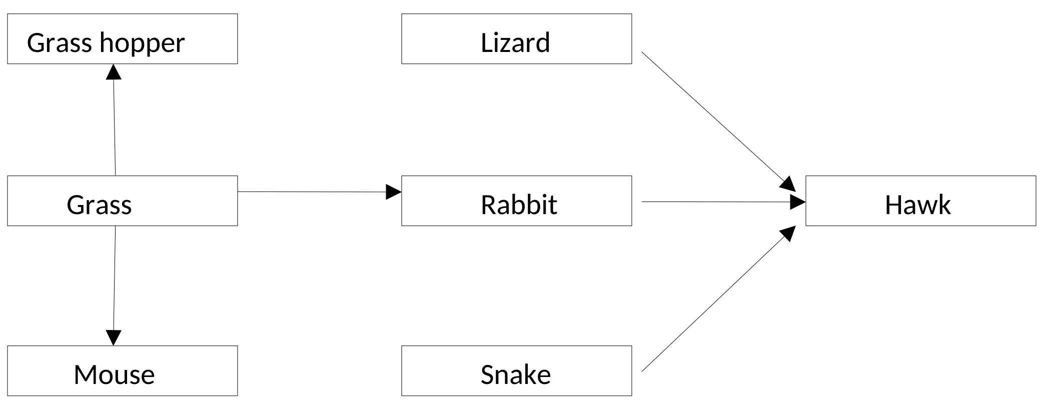
Grass---►Grasshopper----►Frog----►Snake-----►Eagle/Hawk-----►Decomposer----►Grass

Food Chain in a Pond

Aquatic Plants-----►Small Crustacean (hard celled animals)-------►Aquatic insect-----►Small fish----►Large fish-------► Decomposer----► Aquatic plants

3. Food Web

Food chains in natural conditions never operate as isolated sequences, but they are interconnected with each other forming some sort of interlocking patterns, which is referred to as a food web. Thus **the combination of many food chains forming an integrated network is called food web.** In nature, the linear arrangement of food chains hardly occurs and these remain indeed interconnected with each other through different types of organisms at different tropic levels.



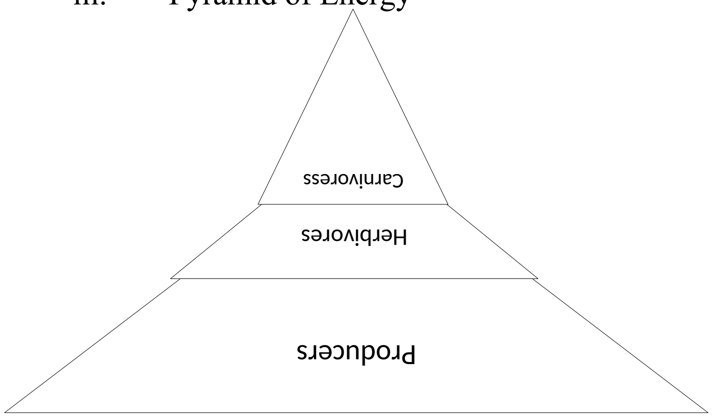
4. Ecological Pyramids

The interaction of the food chain and the metabolism relationship between the linearly arranged various biotic components of an ecosystem is characteristic of each type of ecosystem. This is called a trophic structure. The trophic structure and function at successive trophic levels i.e. producers-----►herbivores--------►carnivores, may be shown graphically by means of ecological pyramids.

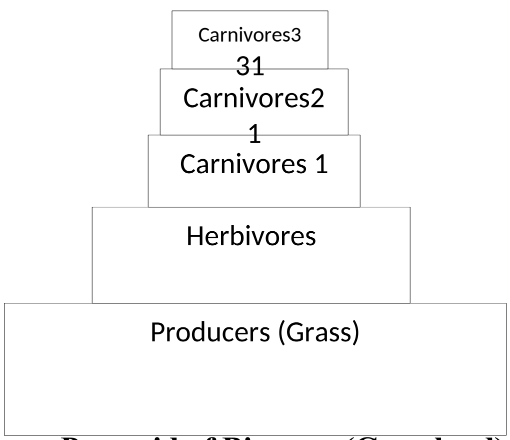
The diagrammatic representation of the number, energy flow or biomass of all trophic levels of an ecosystem in geometrical pyramid form is called Ecological pyramid.

In these pyramids, the first or the producer level constitutes the base of the pyramid followed by herbivores and finally the apex is occupied by carnivores. The ecological pyramid are of three types:

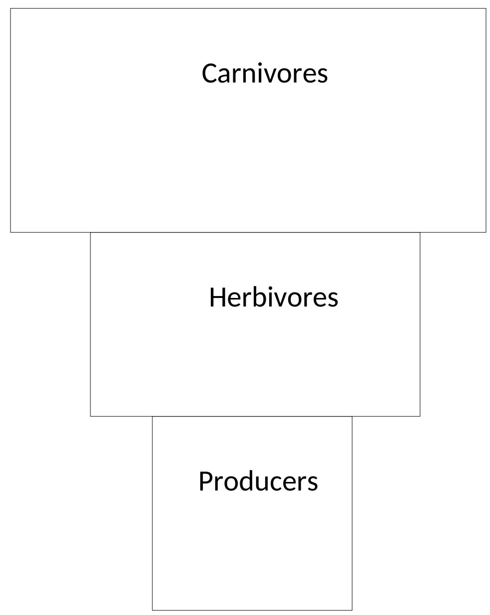
i. Pyramid of numbers’
ii. Pyramid of biomass
iii. Pyramid of Energy



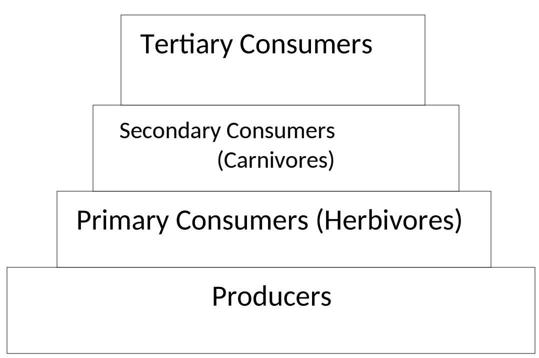
Pyramid of numbers



Pyramid of Biomass (Grassland)



Pyramid of biomass (Pond)



Pyramid of Energy (Rate of passage of food mass through the food chain)

5. Structure of Ecosystem

An ecosystem is an ecological unit consisting of both living (biotic) and non-living (abiotic) factors of the environment. The word ecosystem was first termed by A.G. Tansley in 1935. (eco- environment; system- interaction). Its two major components are:

a. ***Biotic Component***

   It includes all living organisms present in the environment i. e. plants and animals which depend on each other for their food and life. These are producers, consumers and decomposers.

b. ***Abiotic components***

   These constitute the non-living factors in the environment. The major components are water, oxygen, carbonates, phosphorous, calcium and also include physical factors such as temperature, rainfall, light, soil, etc.

Basically ecosystems are of two types:

i. **Natural**
   - Terrestrial Ecosystem
   - Aquatic ecosystem
   - Lentic, the ecosystem of a lake, pond or swamp.
   - Lotic, the ecosystem of a river, stream or spring.

ii. **Artificial ecosystems created by humans.**

Central to the ecosystem concept is the idea that living organisms interact with every other element in their local environment. Eugene Odum, a founder of ecology, stated: "Any unit that includes all of the organisms (i.e. the "community") in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles (i.e.: exchange of materials between living and nonliving parts) within the system is an ecosystem.

6 Examples of Ecosystem

6.1 Terrestrial Ecosystem

6.1.1 Forest ecosystem

Abiotic Components Soil, moisture, air, sunlight

Biotic Components

Producers All the green plants (tree, shrubs, herbs)

Consumers

Primary------► Herbivores (animals feeding on leaves and other parts of the plants, eg deer, birds, bats, squirrels etc.)

Secondary-----► Carnivores like wolves, jackle, pythons etc.

Tertiary---------► Lion, tiger, hawk etc.

Decomposers

Wide variety of micro-organisms, chiefly bacteria, fungi etc.

6.1.2 Grassland Ecosystem

Abiotic Components Soil, moisture, air, sunlight

Biotic Components

Producers Small grass, shrubs and herbs

Consumers

Primary------► Herbivores (animals feeding on leaves and other parts of the plants, eg ants, beetles, sheep, rabbit etc.)

Secondary-----► Carnivores like snakes, birds, jackles, lizard etc.

Tertiary---------► hawk etc.

Decomposers

IT includes wide variety of micro-organisms, chiefly bacteria, fungi etc.

6.2 Aquatic Ecosystem

An **aquatic ecosystem** is an ecosystem in a body of water. Communities of organisms that are dependent on each other and on their environment live in aquatic ecosystems. The two main types of aquatic ecosystems are marine ecosystems and freshwater ecosystems.

6.2.1 Marine Ecosystem

Abiotic Components

Water minerals, Oxygen, nitrogen , sunlight etc.

Biotic Components

Producers Autotrophic phytoplanktons, microscopic algae, etc.

Consumers

Primary------► zooplanktons e.g. crustaceans, molluscans and small fish

Secondary-----► Carnivores fish and other animals

Tertiary---------► Bigger carnivores fish.

Decomposers

IT includes wide variety of micro-organisms, chiefly bacteria, fungi etc.

Marine ecosystems cover approximately 71% of the Earth's surface and contain approximately 97% of the planet's water. They generate 32% of the world's net primary production. They are distinguished from freshwater ecosystems by the presence of dissolved compounds, especially salts, in the water. Approximately 85% of the dissolved materials in seawater are sodium and chlorine. Seawater has an average salinity of 35 parts per thousand (ppt) of water. Actual salinity varies among different marine ecosystems.

Classes of organisms found in marine ecosystems include brown algae, dinoflagellates, corals, cephalopods, echinoderms, and sharks. Fishes caught in marine ecosystems are the biggest source of commercial foods obtained from wild populations.

Environmental problems concerning marine ecosystems include unsustainable exploitation of marine resources (for example overfishing of certain species), marine pollution, climate change, and building on coastal areas.

6.2.2 Freshwater Ecosystem

Freshwater ecosystems cover 0.80% of the Earth's surface and inhabit 0.009% of its total water. They generate nearly 3% of its net primary production. Freshwater ecosystems contain 41% of the world's known fish species. There are three basic types of freshwater ecosystems:

- Lentic: slow-moving water, including pools, ponds, and lakes.
- Lotic: rapidly-moving water, for example streams and rivers.
- Wetlands: areas where the soil is saturated or inundated for at least part of the time.

Two important subclasses of lakes are ponds, which typically are small lakes and water reservoirs. Many lakes, or bays within them, gradually become enriched by nutrients and fill in with organic sediments, a process called eutrophication. Eutrophication is accelerated by human activity within the water catchment area of the lake.

The major zones in river ecosystems are determined by the river bed's gradient or by the velocity of the current. Faster moving turbulent water typically contains greater concentrations of dissolved oxygen, which supports greater biodiversity than the slow moving water of pools.

Wetlands are dominated by vascular plants that have adapted to saturated soil. Wetlands are the most productive natural ecosystems because of the proximity of water and soil. Due to their productivity, wetlands are often converted into dry land with dykes and drains and used for agricultural purposes. Their closeness to lakes and rivers means that they are often developed for human settlement.

6.2.3 Functions of Aquatic Ecosystem

Aquatic ecosystems perform many important environmental functions. For example, they recycle nutrients, purify water, attenuate (make weaker) floods, recharge ground water and provide habitats for wildlife. Aquatic ecosystems are also used for human recreation, and are very important to the tourism industry, especially in coastal regions.

The health of an aquatic ecosystem is degraded when the ecosystem's ability to absorb a stress has been exceeded. A stress on an aquatic ecosystem can be a result of physical, chemical or biological alterations of the environment. Physical alterations include changes in water temperature, water flow and light availability. Chemical alterations include changes in the loading rates of biostimulatory nutrients, oxygen consuming materials, and toxins. Biological alterations include the introduction of exotic (foreign) species. Human populations can impose excessive stresses on aquatic ecosystems.

Abiotic characteristics

An ecosystem is composed of biotic communities and abiotic environmental factors, which form a self-regulating and self-sustaining unit. Abiotic environmental factors of aquatic ecosystems include temperature, salinity, and flow.

The amount of dissolved oxygen in a water body is frequently the key substance in determining the extent and kinds of organic life in the water body. Fish need dissolved oxygen to survive. Conversely, oxygen is fatal to many kinds of anaerobic bacteria.

The salinity of the water body is also a determining factor in the kinds of species found in the water body. Organisms in marine ecosystems tolerate salinity, while many freshwater organisms are intolerant of salt. Freshwater used for irrigation purposes often absorb levels of salt that are harmful to freshwater organisms. Though some salt can be good for organisms.

Biotic characteristics

The organisms (also called biota) found in aquatic ecosystems are either autotrophic or heterotrophic.

Autotrophic organisms

Autotrophic organisms are producers that generate organic compounds from inorganic material. Algae use solar energy to generate biomass from carbon dioxide and are the most important autotrophic organisms in aquatic environments. Chemosynthetic bacteria are found in benthic (Sea bottom) marine ecosystems. These organisms are able to feed on hydrogen sulfide in water that comes from volcanic vents. Great concentrations of animals that feed on these bacteria are found around volcanic vents. For example, there are giant tube worms 1.5m in length and clams 30 cm long.

Heterotrophic organisms

Heterotrophic organisms consume autotrophic organisms and use the organic compounds in their bodies as energy sources and as raw materials to create their own biomass. Euryhaline organisms are salt tolerant and can survive in marine ecosystems, while stenohaline or salt intolerant species can only live in freshwater environments.

7. Environmental Degradation

Environment

This is a difficult word to define. Its actual meaning relates to 'surroundings'. As per EPA 1997, Environment is defined as consisting of "all, or any, of the following media, namely, the air, water and land."

Word "environment" is most commonly used describing "natural" environment and means the sum of all living and non-living things that surround an organism, or group of organisms. Environment includes all elements, factors, and conditions that have some impact on growth and development of certain organism. Environment includes both biotic and abiotic factors that have influence on observed organism. Abiotic factors such as light, temperature, water, atmospheric gases combine with biotic factors (all surrounding living species). Environment often changes after some time and therefore many organisms have ability to adapt to these changes. However tolerance range is not the same with all species and exposure to environmental conditions at the limit of a certain organism's tolerance range represents environmental stress.

The present world is suffering from different kinds of environmental problems. In fact, there is the conflict between environmental values and development. Neither we can abandon the development in the name of environment nor can we ignore the environmental values in the name of the development. For this reason, there must be the proper balance between environment and development. But with the advancement of new science and technology, the environmental problems are still being intensified. The followings are the burning issues related to degradation of environment of the present world.

1. ***Depletion of Ozone layer***
2. ***GHGF Emissions (CO_2, CFC, Methane)***
3. ***Disruption of Bio-Diversity***
4. ***Global warming (Climate Change)***
5. ***Trans boundary Water Pollution***

8. Consequences of Development activities

Human impact on the environment or anthropogenic impact on the environment includes impacts on biophysical environments, biodiversity, and other resources. The term *anthropogenic* designates an effect or object resulting from human activity. The term was first used in the technical sense by Russian geologist Alexey Pavlov, and was first used in English by British ecologist Arthur Tansley in reference to human influences on climax plant communities. The term is sometimes used in the context of pollution emissions that are produced as a result of human activities but applies broadly to all major human impacts on the environment.

The applications of technology (in general) often result in unavoidable environmental impacts. Environmental impacts caused by the application of technology are often perceived as unavoidable for several reasons. First, given that the purpose of many technologies is to exploit, control, or otherwise "improve" upon nature for the perceived benefit of humanity while at the same time the myriad (mass, heap, many, countless) of processes in nature have been optimized and are continually adjusted by evolution, any disturbance of these natural processes by technology is likely to result in negative environmental consequences. Second, the conservation of mass principle and the first law of thermodynamics (i.e., conservation of energy) dictate that whenever material resources or energy are moved around or manipulated by technology, environmental consequences are inescapable. Third, according to the second law of thermodynamics, order can be increased within a system (such as the human economy) only by increasing disorder or entropy outside the system (i.e., the environment). Thus, technologies can create "order" in the human economy (i.e., order as manifested in buildings, factories, transportation networks, communication systems, etc.) only at the expense of increasing "disorder" in the environment. According to a number of studies, increased entropy is likely to be correlated to negative environmental impacts.

Causes of Environmental Impact

Agriculture

The environmental impact of agriculture varies based on the wide variety of agricultural practices employed around the world.

Fishing

The environmental impact of fishing can be divided into issues that involve the availability of fish to be caught, such as overfishing, sustainable fisheries, and fisheries management; and issues that involve the impact of fishing on other elements of the environment, such as by-catch.

These conservation issues are part of marine conservation .There is a growing gap between how many fish are available to be caught and humanity's desire to catch them, a problem that gets worse as the world population grows.

Similar to other environmental issues, there can be conflict between the fishermen who depend on fishing for their livelihoods and fishery scientists who realize that if future fish populations are to be sustainable then some fisheries must reduce or even close.

Irrigation

The environmental impact of irrigation includes the changes in quantity and quality of soil and water as a result of irrigation and the ensuing effects on natural and social conditions at the tail-end and downstream of the irrigation scheme.

The impacts stem from the changed hydrological conditions owing to the installation and operation of the scheme. An irrigation scheme often draws water from the river and distributes it over the irrigated area. As a hydrological result it is found that:

- the downstream river discharge is reduced
- the evaporation in the scheme is increased
- the groundwater recharge in the scheme is increased
- the level of the water table rises
- the drainage flow is increased.

These may be called direct effects and the effects thereof on soil and water quality are indirect and complex, Water logging and soil salination are part of these, whereas the subsequent impacts on natural, ecological and socio-economic conditions is very intricate.

Irrigation can also be done extracting groundwater by (tube) wells. As a hydrological result it is found that the level of the water descends. The effects may be water mining, land/soil subsidence, and, along the coast, saltwater intrusion.

Irrigation projects can have large benefits, but the negative side effects are often overlooked. Agricultural irrigation technologies such as high powered water pumps, dams, and pipelines are responsible for the large-scale depletion of fresh water resources such as aquifers, lakes, and rivers. Humans appropriate more than 50% of the planet's fresh water, mostly for use in irrigation. As a result of this massive diversion of freshwater, lakes, rivers, and creeks are running dry, severely altering or stressing surrounding ecosystems, and contributing to the extinction of many aquatic species.

Topsoil loss

The industrialization of agriculture during the last 150 years, specifically the widespread use of fossil fuel powered farm machinery for plowing, has resulted in massive top soil loss. Soils are currently lost at the rate of inches per decade while it takes hundreds of years for one inch of new topsoil to form. Worldwide, about one third of arable land has been lost due to erosion.

Meat production

The environmental impact of meat production includes pollution and the use of resources such as fossil fuels, water, and land. According to a 2006 report by the Livestock, Environment And Development Initiative, the livestock industry is one of the largest contributors to environmental degradation worldwide, and modern practices of raising animals for food contributes on a "massive scale" to air and water pollution, land degradation, climate change, and loss of biodiversity. The initiative concluded that "the livestock sector emerges as one of the top two or three most significant contributors to the most serious environmental problems, at every scale from local to global." In 2006 FAO estimated that meat industry contributes 18% of all emissions of greenhouse gasses. The production and consumption of meat and other animal products is associated with the clearing of rainforests, resource depletion, air and water pollution, land and economic inefficiency, species extinction, and other environmental harms.

Energy industry

The environmental impact of energy harvesting and consumption is diverse. In recent years there has been a trend towards the increased commercialization of various renewable energy sources.

In the real world of consumption of fossil fuel resources lead to global warming and climate change. However, little change is being made in many parts of the world. If the peak oil theory proves true, more explorations of viable alternative energy sources could be friendlier to the environment.

Rapidly advancing technologies can achieve a transition of energy generation, water and waste management, and food production towards better environmental and energy usage practices using methods of systems ecology and industrial ecology.

Biodiesel

The environmental impact of biodiesel is diverse. It includes greenhouse gas emissions, pollution, biodegradation, biodegradation in aquatic environments, and carbonyl emissions.

Coal mining and burning

The environmental impact of coal mining and burning is diverse like toxic pollution from coal-fired power plants.

Electricity generation

The environmental impact of electricity generation is significant because modern society uses large amounts of electrical power. This power is normally generated at power plants that convert some other kind of energy into electricity. Each such system has advantages and disadvantages, but many of them pose environmental concerns.

Nuclear power

The environmental impact of nuclear power results from the nuclear fuel cycle processes including mining, processing, transporting and storing fuel and radioactive fuel waste. Released radioisotopes pose a health danger to human populations, animals and plants as radioactive particles enter organisms through various transmission routes.

Radiation is a carcinogen and causes numerous effects on living organisms and systems. The environmental impacts of nuclear power plant releases such as the Chernobyl disaster, the Fukushima Daiichi nuclear disaster and the Three Mile Island accident, among others, persist indefinitely.

Oil shale industry

The environmental impact of the oil shale industry includes the consideration of issues such as land use, waste management, and water and air pollution caused by the extraction and processing of oil shale. Surface mining of oil shale deposits causes the usual environmental impacts of open-pit mining. In addition, the combustion and thermal processing generate waste material, which must be disposed of, and harmful atmospheric emissions, including carbon dioxide, a major greenhouse gas.

Petroleum

The environmental impact of petroleum is often negative because it is toxic to almost all forms of life. The possibility of climate change exists. Petroleum, commonly referred to as oil, is closely linked to virtually all aspects of present society, especially for transportation and heating for both homes and for commercial activities.

Reservoirs

The environmental impact of reservoirs is coming under ever increasing scrutiny as the world demand for water and energy increases and the number and size of reservoirs increases.

Dams and the reservoirs can be used to supply drinking water, generate hydroelectric power, increasing the water supply for irrigation, provide recreational opportunities and to improve certain aspects of the environment. However, adverse environmental and sociological impacts have also been identified during and after many reservoir constructions. Although the impact varies greatly between different dams and reservoirs, common criticisms include preventing sea-run fish from reaching their historical mating grounds, less access to water downstream, and a smaller catch for fishing communities in the area.

Wind power

Compared to the environmental impact of traditional energy sources, the environmental impact of wind power is relatively minor. Wind power consumes no fuel, and emits no air pollution, unlike fossil fuel power sources. The energy consumed to manufacture and transport the materials used to build a wind power plant is equal to the new energy produced by the plant within a few months. While a wind farm may cover a large area of land, many land uses such as agriculture are compatible, with only small areas of turbine foundations and infrastructure made unavailable for use.

There are reports of bird and bat mortality at wind turbines, as there are around other artificial structures. The scale of the ecological impact may or may not be significant, depending on specific circumstances. There are conflicting reports about the effects of noise on people who live very close to a wind turbine.

Manufactured products

Cleaning agents

The environmental impact of cleaning agents is diverse. In recent years, measures have been taken to reduce these effects.

Paint

The environmental impact of paint is diverse. Traditional painting materials and processes can have harmful effects on the environment, including those from the use of lead and other additives. Measures can be taken to reduce environmental impact, including accurately estimating paint quantities so that wastage is minimized, use of paints, coatings, painting accessories and techniques that are environmentally preferred. The United States Environmental Protection Agency guidelines and Green Star ratings are some of the standards that can be applied.

Paper

The environmental impact of paper is significant, which has led to changes in industry and behavior at both business and personal levels. With the use of modern technology such as the printing press and the highly mechanized harvesting of wood, paper has become a cheap commodity. This has led to a high level of consumption and waste. With the rise in environmental awareness due to the lobbying by environmental organizations and with increased government regulation there is now a trend towards sustainability in the pulp and paper industry.

Pesticides

The environmental impact of pesticides is often greater than what is intended by those who use them. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non target species, air, water, bottom sediments, and food. Pesticide contaminates land and water when it escapes from production sites and storage tanks, when it runs off from fields, when it is discarded, when it is sprayed aerially, and when it is sprayed into water to kill algae.

The amount of pesticide that migrates from the intended application area is influenced by the particular chemical's properties: its propensity for binding to soil, its vapor pressure, its water solubility, and its resistance to being broken down over time. Factors in the soil, such as its texture, its ability to retain water, and the amount of organic matter contained in it, also affect the amount of pesticide that will leave the area. Some pesticides contribute to global warming and the depletion of the ozone layer.

Pharmaceuticals and personal care products

The environmental impact of pharmaceuticals and personal care products (PPCPs) is largely speculative. PPCPs are substances used by individuals for personal health or cosmetic reasons and the products used by agribusiness to boost growth or health of livestock. PPCPs have been detected in water bodies throughout the world. The effects of these chemicals on humans and the environment are not yet known, but to date there is no scientific evidence that they have an impact on human health.

Mining

The environmental impact of mining includes erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. In some cases, additional forest logging is done in the vicinity of mines to increase the available room for the storage of the created debris and soil. Besides creating environmental damage, the contamination from leakage of chemicals also affect the health of the local population.

Transport

The environmental impact of transport is significant because it is a major user of energy, and burns most of the world's petroleum. This creates air pollution, including nitrous oxides and particulates, and is a significant contributor to global warming through emission of carbon dioxide, for which transport is the fastest-growing emission sector. By subsector, road transport is the largest contributor to global warming.

Environmental regulations in developed countries have reduced the individual vehicles emission; however, this has been offset by an increase in the number of vehicles, and more use of each vehicle. Some pathways to reduce the carbon emissions of road vehicles considerably have been studied.

Other environmental impacts of transport systems include traffic congestion and automobile-oriented urban sprawl, which can consume natural habitat and agricultural lands. By reducing transportation emissions globally, it is predicted that there will be significant positive effects on Earth's air quality, acid rain, smog and climate change.

Aviation

The environmental impact of aviation occurs because aircraft engines emit noise, particulates, and gases which contribute to climate change and global dimming. Despite emission reductions from automobiles and more fuel-efficient and less polluting turbofan and turboprop engines, the rapid growth of air travel in recent years contributes to an increase in total pollution attributable to aviation.

Roads

The environmental impact of roads includes the local effects of highways (public roads) such as on noise, water pollution, habitat destruction/disturbance and local air quality; and the wider effects including climate change from vehicle emissions.

Shipping

The environmental impact of shipping includes greenhouse gas emissions and oil pollution. Carbon dioxide emissions from shipping is currently estimated at 4 to 5% of the global total, and estimated by the International Maritime Organization (IMO) to rise by up to 72% by 2020 if no action is taken. There is also a potential for introducing invasive species into new areas through shipping, usually by attaching themselves to the ship's hull.

War

As well as the cost to human life and society, there is a significant environmental impact of war. Modern technology war can cause a far greater devastation on the environment. Unexploded ordnance can render land unusable for further use or make access across it dangerous or fatal.

Effects

Biodiversity

Human impact on biodiversity is significant, humans have caused the extinction of many species, including the dodo and, potentially, large mega faunal species during the last ice age. Though most experts agree that human beings have accelerated the rate of species extinction, the exact degree of this impact is unknown. Some authors have postulated that without human interference the biodiversity of this planet would continue to grow at an exponential rate.

Coral reefs

A **reef** is a rock, sandbar, or other feature lying beneath the surface of the water (80 meters or less beneath low water. Human impact on coral reefs is significant. Coral reefs are dying around the world. In particular, coral mining, pollution (organic and non-organic), overfishing, blast fishing and the digging of canals and access into islands and bays are serious threats to these ecosystems. Coral reefs also face high dangers from pollution, diseases, destructive fishing practices and warming oceans. In order to find answers for these problems, researchers study the various factors that impact reefs. The list of factors is long, including the ocean's role as a carbon dioxide sink, atmospheric changes, ultraviolet light, ocean acidification, biological virus, impacts of dust storms carrying agents to far flung reefs, pollutants, algal blooms and others. Reefs are threatened well beyond coastal areas.

Carbon cycle

Global warming is the result of increasing atmospheric carbon dioxide concentrations which is caused primarily by the combustion of fossil energy sources such as petroleum, coal, and natural gas. Such massive alteration of the global carbon cycle has only been possible because of the availability and deployment of advanced technologies, ranging in application from fossil fuel exploration, extraction, distribution, refining, and combustion in power plants and automobile engines. Potential negative environmental impacts caused by increasing atmospheric carbon dioxide concentrations are rising global air temperatures, altered hydro geological cycles resulting in more frequent and severe droughts, storms, and floods, as well as sea level rise and ecosystem disruption.

Nitrogen cycle

The nitrogen cycle is the process by which nitrogen is converted between its various chemical forms. This transformation can be carried out through both biological and physical processes.

Important processes in the nitrogen cycle include fixation, ammonification, nitrification, and denitrification. The majority of Earth's atmosphere (78%) is nitrogen, making it the largest pool of nitrogen. However, atmospheric nitrogen has limited availability for biological use, leading to a scarcity of usable nitrogen in many types of ecosystems.

The nitrogen cycle is of particular interest to ecologists because nitrogen availability can affect the rate of key ecosystem processes, including primary production and decomposition. Human activities such as fossil fuel combustion, use of artificial nitrogen fertilizers, and release of nitrogen in wastewater have dramatically altered the global nitrogen cycle

Human activities account for over one-third of N_2O emissions, most of which are due to the agricultural sector.

Ecosystem and Development

A living organism has its specific surrounding to which it continuously interacts and remains fully adapted. The life supporting environment of planet earth is restricted to a thin film of air, water and soil having an approximate thickness of 5-20 km. This special shell of earth is known as ecosphere or biosphere. The biosphere is that part of the earth in which life exists. It is composed of the following chief media. :

Atmosphere--- the sphere of air

Hydrosphere--- the sphere of liquid water

Lithosphere---- the sphere of solid and loose rocks

The interrelation between the physical and the biological world is a continuous process. This process takes place in a continuous circulation of substances between organisms and their physical environment. Substances such as oxygen, carbon dioxide and minerals are constantly absorbed by organisms from the environment, used and again replaced by the organisms themselves through processes like photosynthesis, respiration, excretion and decay in the biological world. Because of this , important elements like oxygen, carbon dioxide, nitrogen, water and minerals are always available in the same proportion and balance is maintained in the nature. When the balance is disturbed, various environmental hazards such as erosion, siltation, pollution, loss of natural genetic resources, etc may appear.

Ecosystem supports the lives of living beings including human. We get food, water, oxygen and other vital things from the ecosystem. Ecosystem absorbs the pollution induced from development activities. Ecosystem absorbs carbon dioxide generated from industries, vehicles and other development activities. Industrial wastes and sewages disposed to the water bodies are also absorbed and purified by ecosystem. But we should not forget that the absorbing capacity of the ecosystem is limited. When manmade pollution created by development activities exceeds the absorbing capacity of the ecosystem, then ecosystem cannot support it and all the components of ecosystem will suffer. That will disturb the natural balance of ecosystem. For example, when we dispose excess industrial wastes than the absorbing capacity of the water bodies, the lives of aquatic plants and animals will be endangered. Ultimate sufferer will be human himself due to reduced production of fishes.

Similarly development activities destroy forest and agricultural lands which reduces carbon dioxide absorbing plants in one hand and at the same time development activities produces more carbon dioxide. Due to this dual effect, the natural balance of carbon dioxide on ecosphere is disturbed causing the ill effect on ecosystem such as global warming.

The major threats of development activities on ecosystem are cultivation on steep slopes, overgrazing, major engineering activities, over-exploitation of village or community forests, unplanned tourism, urbanization and other land uses. Sedimentation, changes in surface and groundwater hydrology and clear felling of broadleaf plant species have caused eutrophication (depletion of oxygen in water), the drying of springs and glacier recession. Population pressure, migration and settlements are the principal causes of poverty and environmental degradation. Conservation and environmentally sustainable development are to be promoted which emphasize the re-establishment of forests and vegetation to minimize erosion, the protection of wildlife, and economic development which does not damage the environment.

Healthy ecosystems are the foundation for sound economies, sustaining and enhancing human life with services ranging from food and fuel to clean air and water. As such, ecology has an important role to play in society's efforts to improve the quality of life throughout the world. Although ecological scientists have neither the remit nor the capacity to judge the right of people to grow their economies, they do have the expertise and the responsibility to identify the ecological consequences of current and alternative growth strategies, recognizing that:

- Human activities can degrade ecosystems, diminishing ecosystem services of value to society (***loss of natural capital)***
- Many ecosystem services such as clean air are ***public goods—***they are freely and indiscriminately available to all members of a community, giving stakeholders little incentive to maintain them
- In cases where ecosystem services do have a market value (e.g. food and fiber), economic activities may have ecological impacts that are not captured in market prices (***environmental externalities)***
- Society's ability to predict the consequences of ecosystem change is limited ***(environmental uncertainty***) but can be improved with new modeling and forecasting tools

The Millennium Ecosystem Assessment provides a comprehensive review of the status, trends, and possible future conditions of ecosystems, ecosystem services, and human welfare. Its findings include:

- "Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth."
- "The changes that have been made to ecosystems have contributed to substantial net gains in human well-being and economic development, but these gains have been achieved at growing costs in the form of the degradation of many ecosystem services, increased risks of nonlinear changes, and the exacerbation(make worse) of poverty for some groups of people. These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems."

Why is our current approach to development unsustainable?

Ecologically sustainable development must maintain ecosystem resilience—the continued ability of ecosystems to provide future generations with services in spite of natural and human-driven disturbances. Many current ecosystem management strategies are unsustainable, focusing on a single service—such as the production of food, fuel, or fiber—to the neglect of others. Such strategies can reduce biodiversity and ecosystem resilience by eliminating native species, introducing new and harmful species, converting and simplifying habitat, and polluting the surrounding environment.

In addition to reducing resilience, these strategies reduce the capacity of ecosystems to deliver other important services. For example, harvesting timber might provide a near-term profit to the owner of wooded land, but only at the expense of the ecosystem services that the forest ecosystem once provided, such as clean water, carbon sequestration, and recreational opportunities. Humanity as a whole will not necessarily be "richer."

How can we determine sustainability?

Human wellbeing depends on numerous forms of wealth. People's quality of life is determined not only by their property (produced capital), but also by their skills (human capital), their social institutions (social capital), and their biophysical environment (natural capital). Some of this wealth is in private hands, but much belongs to communities, and resources such as the atmosphere belong to all of humanity. Sustainable investment should be informed by gains and losses in all forms of capital, across all ownership categories.

Most conventional measures of economic growth, such as Gross National Product, focus exclusively on produced capital. This provides decision makers with little incentive to safeguard natural, social, and human capital. The best test of sustainability is to determine whether average inclusive wealth (all forms of capital taken together) is being maintained. There have been very few attempts to measure inclusive wealth, but measurements that do exist, such as the World Bank's concept of adjusted net saving, indicate that the growth patterns of many nations are currently unsustainable.

How to solve the problems?

- *Internalize externalities*

  Environmental impacts and resource shortages caused by economic activities often affect people far removed in space and time from those whose actions produced these problems. This separation of cause from consequence represents what economists refer to as externalities. Agribusiness, for example, benefits from using nitrogen fertilizers but does not bear the costs associated with oxygen-depleted "dead zones" that agrochemical runoff produces in aquatic ecosystems. Because the adverse environmental impacts of fertilizer use are not reflected in fertilizer prices, they do not affect decisions about how much fertilizer to use .

  Resolving this disparity would drive more environmentally and socially sustainable investments, but only following significant changes to our existing economic framework. Environmental economists advocate a range of measures to internalize externalities. Examples include property rights for environmental assets, payments for ecosystem services, and liabilities for environmental damage. Developing effective incentives requires an in-depth understanding of the ecological implications of externalities.
- *Create mechanisms for sustaining ecosystem services*

  Environmental economists have long recommended creating markets for ecosystem services such as pest control and carbon sequestration (confiscation. Seizure). Such markets would provide incentives for environmentally sound investments, while allowing communities to be compensated for actions that benefit others. Whether this means clean air in Beijing, China or safe drinking water in Central Valley, California, people would be able to invest in their welfare and the welfare of their children, just as they are currently able to invest in more material forms of security.

Markets must often be coupled with other strategies in order to be effective. In the emerging market for carbon sequestration, for example, if sequestration is priced while other services like freshwater provisioning remain unpriced, negative ecological outcomes may ensue. Carbon markets need to be paired with other strategies, such as the regulation of land use, the direct protection of biodiversity, and the development of "green standards" to which projects must adhere.

- *Enhance decision makers' capacity to predict environmental impacts*

Society is growing increasingly aware of the economic repercussions of environmental change. Still, this linkage often only becomes apparent after the environment has been damaged, sometimes irreversibly. Routine assessments of environmental risks, such as environmental impact statements, play an important role in identifying short-term environmental damage, but they rarely account for impacts that take decades to emerge. For example, DDT, a synthetic pesticide, was widely used for almost 20 years before its harmful effects on human and bird populations were recognized. The resulting US ban on DDT led to marked recoveries in bald eagles and other impacted species, but not all environmental impacts can be reversed with such success. Similarly, deforestation in Panama displaced mosquito populations in the canopy, causing a dramatic increase in Yellow Fever cases. Such outbreaks of zoonotic diseases are rarely foreseen in routine environmental risk assessments but can quickly escalate to unmanageable proportions, leading to the loss of countless human lives as well as billions of dollars in damages, lost output, and livestock mortality.

Recognizing that environmental impacts are often highly uncertain, it is important to develop models better able to project the consequences of anthropogenic environmental change. Equally important are new monitoring systems to detect problematic trends before they surpass society's ability to address them.

- *Manage for resilient ecosystems*

when ecosystem thresholds are breached, undesirable and often irreversible change can occur. For instance, grassy savannas capable of supporting grazing and rural livelihoods can suddenly "flip" to woody systems with lower productive capacity. Many common management strategies move ecosystems closer to these thresholds. Ecosystem management strategies need to leave a "margin of error", trading some short-term yield for long-term resilience that sustains a suite of services.

References:

1. *United Nations. The Millennium Development Goals Report 2008. United Nations, New York.*

2. *World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press, Oxford.*

3. *Millennium Ecosystem Assessment (MA). 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, D.C.*
4. *Common Roots for Transfer of Culture: M. Vannucci*

5. *Wikipedia*