Environment and Elements of Ecology

Introduction

Dear friends. In this session we shall try to understand the environment and the elements of ecology. The subject matter is related to social science, like economics and natural sciences. The nature of the subject is interrelated in the sense that it can be understood by knowing the linkages between social science and the natural sciences. In other words, it is interdisciplinary in nature.

As the rising problems of environment become serious, the natural scientists came close to economics in order to understand that how ecology is linked with economics. They wanted to understand that how ecological imbalance created by pursuit of economic growth through exploitation and depletion of natural resources, affects the economic system. They realized that basic principles of economics and their application can give better understanding of environmental problems and issues. On the other hand economics being social science with scientific content and empirical elements has space and potential to absorb and explain the problems of other disciplines. Moreover, it also contains comprehensive tool kits to explain and analyze them.

Resources for the future (RFF), a Washington based institutions, is an independent, nonpartisan think tank, funded in 1952, it pioneered the application of economics as a tool for developing more effective policy about the use and conservation of natural resources. Its scholars employ social science methods to analyze critical issues concerning pollution control, energy policy, land and water use, hazardous waste, climate change, biodiversity and the environmental changes of developing countries. It stands for a broad range of approaches to the study of natural resources and the environment. It aims at how economics and other social science research can make toward improving public debate and decision making. It contributes to broad range of environmental regulation, hazardous and toxic waste, environmental equity, and the environmental challenges in developing countries. Global climate change, sustainability,

environment and public health and the growing problem of antibiotic and pesticide resistance are also covered under its study.

However, economic analysis of environmental problems has emerged as a new field and more innovative applications of economic analysis have come into being. It was thought in end eighties that environmental problems were not bringing adequately depth with from the existing mono disciplinary perspective which required a new trans disciplinary treatment.

We as an environmentalists are seriously concern with the truly things being done to the air, water and the habitats of the numerous species, global warming and the needless waste of resources associated with modern patterns of consumption. The damage to ecosystem is a far greater threat to the way people live; they are causing harm to environmental systems in which they live.

The industries, firms, different plants, including government's plants, launched for development, damage and degrade environment. They discharge waste, pollute air, water and noise.

Connection between the Environment, Human society and the Economy

There is a threefold connection between Environment, Human society and the economy;

(1) The raw materials flow from environment, transformed into consumer products through the production process.
(2) Environment provides services which are directly used by consumer, e.g. oxygen in the air, water that we drink and natural beauty that gives us pleasure, we enjoy natures aesthetic etc.
(3) It takes the waste within it, which results by process of production and consumption. It also acts upon the waste product to clean up the environment and recycle the waste into materials that can be reused.

The problems of environmental degradation are related to an interference that occurs in this relationship that restricts the delivery of goods and services, directly or indirectly provided by environment to the economy. This either slow down or

completely stops process of natural clean up. It is this interference that lies at the root of all environmental problems. It is worth to note that mostly such interference in nature's delivery of goods and services to human society is created unintentionally and in the course of production or consumption activity within the economy.

Elements of Ecology

Basically ecology is the Trans disciplinary subject. It is a synthesis of economics and ecology where in we examine the relationships between human and non human and the elements of nature on our planet. In the literature environment and ecology are often used interchangeably. However, there are crucial differences between them. Ecological economics is consciously more methodologically pluralist, while environmental economics is based on neoclassical economic principles which emphasize maximizing human welfare and using economic incentives to modify destructive human behavior, ecological economics uses a variety of methodologies, including neoclassical economics depending upon the purpose of the investigation.

This could be competitive choice-wise and complementary association wise. Even though they could be complementary, significant differences exist not only between them but also within them over such topics as the valuation of environmental resources, the impact of trade on the environment and the appropriate means for evaluating policy strategies for long-duration problems such as climate change.

What is ecology?

Ecology is a term derived from the Greek word Oikos meaning home or habitat. Literally ecology means the study of home or habitat. In order to understand what ecology involves, we must first understand the ecosystem.

Ecosystem

It describes the community of living organizations and their interactions with one another, plus the environment in which they live and also interact. Thus it

includes both living and non living components and the links between them. The term can be applied at any scale, e.g, a pond, rainforest, oceans or even the earth itself. Broadly speaking, in the existence and functioning of the planet Earth, there occurs a complex set of relationships between objects both living and non living. These relationships primarily constitute the dependence of one type of matter upon another. Man and other animals interact with plants and micro-organisms, and each depends on the other for its existence. These living beings in turn interact with and depend upon non-living world comprising of air, water, and soil, with all their contents. The non-living world, too in some ways depends upon and is regenerated by living organisms. The functioning of this complex system therefore involves relationships that are governed by the laws of the physical sciences and biology. This complex set of friendly and inimical relations make up the ecosystem.

Precisely, in other words ecology is the science of studying the ecosystem, the word ecology often indicates the ecosystem itself.

Ecology and Environment

Environment is concept that keeps some privacy to mankind in center. It puts man at the center of these complex set of relationships and maps the set via the dependence of man on other living and non-living objects. In that sense, ecology is a very broad concept that encompasses in its ambit all natural relationships. In contrast environment is a concept, not so broad, that is primarily interested in those relationships that mainly affect the existence of man. In the final analysis every relationship in ecology does somehow affect man, and hence the two concepts may be thought to be one and the same, however there is certain difference. For example an environmentalist is mostly be very concerned about air and water pollutants for human health, and would endeavor to resource the pollutants. He would be less interested and concerned for the fishes, live in rivers and oceans. He would be less concerned for vegetation, Plants, animals and biodiversity.

It is worth to note that the study of environment must constantly borrow from the sciences that study the ecosystem. It should not merely confine to the study

environment with regard to negative externalities of environmental disturbances which are causing peril to human existence.

The Gaia Hypothesis

This hypothesis was found by Lovelock. After his retirement from NASA he devoted his time to the study of interaction of life on earth. Gaia is the name of the ancient Greek goddess “Mother Earth”. The hypothesis, named after the goddess, simply believes that organisms do not simply adapt the physical environment but actively interact with it to modify the physical and chemical conditions of the biosphere. Lovelock studied many disciplines in order to pursue an interdisciplinary study for the purpose of testing the Gaia hypothesis

This hypothesis rests upon two observations.

1. The earth is a super-ecosystem with numerous interacting functions and feedback loops. These maintain life-supporting temperature and the chemical composition of the atmosphere and oceans at a relatively stable level.
2. After life appeared on earth, organisms played an active role in modifying the ambient conditions on earth for the maintenance of life-supporting conditions.

The Ecosystem and Its Cycles

The ecosystem explains a complex set of relationships between all living organisms and non-living organisms and non-living matter on earth. These relationships are dynamic between each combination of elements, for example, between topsoil formation and fertility of land. Herbivorous animals like cattle survive by eating the plants and trees. The nutrients to the soil are formed by carcasses of insects, reptiles and animals. This ecological relationship is cyclical. Ecologists have divided all participating elements into basic subdivisions, emerged by functioning of the ecosystems. These are:

1. The biotic component that includes all living organisms, that is all life forms that follow the process of birth and death.

2. The antibiotic component that includes all physical, non-living elements that provide sustenance to the living organisms.

Keeping in mind these two subdivisions we can see the participating elements in each category.

The Biotic Component

The biotic component consists of these categories:

1. Plants, that depend primarily upon soil nutrients, water and sunglight;
2. Animals including reptiles, rodents, insects, birds and fishes.
3. Man has capacity to adapt and modify nature with the use of technology.
4. Mirco-organisms including parasitic and saprophytic bacteria and fungi, feed primarily upon other living or dead organisms also some non-biotic elements.

Abiotic Component

This is pertaining to non-living component of nature around us. It shows the role played by the air, water and the earth as we go about our daily business. Like the life cycle, the non-living aspects of nature from a complex interrelationship amongst each other and with the biotic part. It is this interrelationship that makes existence possible.

The abiotic component of our planets consists of three elements:

1. The solid matter of earth starting with topsoil or dust, and all its solid components under the ground including minerals and metallic ores called lithosphere.
2. The water in the oceans and in the rivers, lakes and ponds, including marshes and wetland, as well as the ice and snow on the mountains called the hydrosphere.
3. The gaseous mixture around us including nitrogen and oxygen and water vapour, called the atmosphere.

There are other elements which play an important role in this area, namely; the radiant energy that flows from the sun which maintains temperature on plants and the gravitational force that makes the seasons possible and create winds and tides. Other elements such as nitrogen, potassium, calcium and phosphorous etc. also play their part.

Energy Flow and Energy System Dynamics

The main source of energy for our planet is the Sun. This flow of energy through the ecosystem is fundamental element in the operation of the cycles. It is solar radiant energy alone that continues to supply us with this vital input that is the basis of all life processes on earth. Without this continuous and abundant supply of solar energy our planet would be dead. This is the reason that why ecologists often talk about the importance of living within the 'Sunlight budget'. All life processes including all planned activities of productions and consumption depend directly or indirectly upon energy provided by the Sun and the Sum total of these activities may not exceed the volume that can be supported by the solar energy we get.

Apart from providing light and warmth to all living creatures directly, the importance of solar energy lies in the fact that it forms the basis of food chain.

The energy finally reaching the earth's surface serves two main uses:

1. A part of the energy is used in photosynthesis that forms the basis of the food chain.
2. The rest of the energy is used in heating water in the rivers and oceans, giving rise to the hydrological cycle, as well as to heat up the land and air.

The photosynthesis is the process by which green plants use light energy to produce chlorophyll that is the basis of food chain.

The flow of energy through the food chain is also other energy flows in the ecosystem are governed by the laws of thermodynamics.

Alfred James Lotka (1880-1949) who applied the laws of thermodynamics to ecology with idea of the organic and inorganic world functioned as a single system

with all components link through the laws of thermodynamics in a complex and intimate way. He held that it was improper to try to understand each part unless one aimed to understand the whole.

Progogive a Nobel Prize winner found that organisms and ecosystem maintain their highly organized low entropy (low disorder) state by transforming energy from high to low utility states. Living systems and the whole biosphere are 'away from equilibrium system' that have 'efficient dissipative structure' to flush out the disorder. His main contribution was to non-equilibrium thermodynamics. He was able to explain with the help of non-equilibrium thermodynamics why it often appeared that living systems were contradicting the entropy law by maintain an open away from equilibrium state.

Finally, it should be noted that while entropy involves the increase in the level of degradation of energy, its effects on the living process are not entirely negative because while the quantity of available energy declines in every conversion the quality of such energy is greatly improved.

Biogeochemical cycles

These cycles deal with Hydrogen, Oxygen and carbon. They also include Nitrogen, Phosphorous, Potassium, Calcium, Sulphur, Magnesium and iron. These elements are extremely important elements needed by plants and animals. The Zinc, Cobalt, Copper, Manganese and Boron are also part of these cycles.

There are two types of biogeochemical cycles:

1. **Gaseous Cycles:** These are cycles where element concerned must pass through a gaseous phase before the cycle can be completed.
2. **Sedimentary Cycles:** In these cycles elements need not pass through the gaseous phase before the cycle can be completed.

There are many cycles like these cycles namely; carbon cycle, Nitrogen Cycle, Hydrological Cycle and Oxygen cycle. They are the matter of study of natural sciences, but they being the part of ecology and related with ecosystem, have

bearing on environment, through which we see far reaching eco-social and cultural consequences.

The Cycle of Biological Production and Destruction

This is pertaining to biological production followed by two processes that we have discussed namely; energy flow and cycling of materials. They both occur simultaneously and concurrently. As a consequence of these two simultaneous processes a variety of biological species are produced in the ecosystem. When this cycle is disturbed by environmental degradation, then we see the effect on economy and its different aspects. Moreover the growth of plants, crops trees, vegetation animal species and population species are covered under this heading.

The State of Environmental Degradation

Since last two decades or so the environmental pollution and degradation are mounting getting serious and more or less have reached to extreme. The problems are not area or country specific, though their severity and extent may be different in amount and degree, but now they are the matter of global concern. World over awareness has been generated, law and regulations are laid down, different policies have been designed to arrest pollution, degradation and conservation of natural resources and maintaining, preserving climate and protect biodiversity and also maintaining sustainability. Let us try to understand the main sources of environmental degradation.

(1) Air Pollution

It is one of the most serious environmental problems. It directly affects the humans, animals, plants and many other natural elements. Smoke, ash and dust are major constituents of suspended particulate and sulphur and nitrogen based compounds. Air pollution is basically urban and industrial phenomenon. In urban areas owing increasing automobiles, heavy motors, trucks, auto rickshaws are releasing gas and smokes. Industrial activities thermal power stations top the list of air polluters due to the high amount of discharge of smoke and ash. There are about 66 thermal power stations in India and together they generate one lakh tones of fly ash per day as also quantities of smoke. Air pollution is caused by

every industrial activity where fossil fuels are burnt. Industries like steel, cement, chemical and fertilizer plants and also industrial accidents are generating air pollution. Construction activities and open quarries too generate air pollution. In India 10 lakh tones of carbon dioxide, 2 lakh tones of hydrogen sulphide and 5o lakh tones of suspended particulate matter are released into the air per day. It has been suggested that the installation of hydroelectric plants and method of direct pollution abatement can restrict the air pollution.

(2) Water pollution

The sources of water are sea, ocean, rivers, lakes; pond water shades reservoirs and streams. These water bodies yield considerable environmental and aesthetic benefits and are crucial to the preservation of biodiversity in fish and bird species. The water wealth gets polluted by industrial waste, urban sewage, solid waste and agricultural pollutants.

The water wealth gets polluted by industries which makes it unsafe and impure for human use. Environmental threat in this regard is to fisheries and birds.

The central pollution control Board has drawn up a list of 17 industries that are the worst polluters. The prominent among them are petroleum refineries, paper mills wineries, textile mills and chemical industries.

(3) Deforestation

Forests are full of trees, herbs, animals, reptiles, birds and insects. They are the residence of wild animals. They are also sources of natural resources. Deforestation stems from two main sources, namely; Commercial demand of timber by industries and people and the wave of urbanization and industrialization.

(4) Noise Pollution

This form of pollution is not material related but activity related. It is basically urban phenomenon cased by industrialization and arising out of congested living. The density of population, large amount of automobiles and extensive use of machinery adversely affects the health of population.

(5) Disposal of Reactive Waste and the danger of Radiation

This kind of pollution arises from the uses of nuclear material like Uranium and Plutonium. The advantage of nuclear power plant is that it provides cheap, clean and compact energy. But the disposal of waste nuclear fuel pollutes the environment.

(6) Climate Change

Climate change is very serious environmental problem for its all round negative effect on entire planet and all that exists on it. The natural proportionate combination of these elements turns very awkward by environmental disturbances and causing serious problem for mankind and species exist on earth. Human industrial activity, mainly the combustion of fossil fuels, has resulted in large scale production of certain gases such as carbon monoxide and carbon dioxide and oxides of nitrogen that have heat trapping properties. These form a shield in the upper atmosphere. Now earth receives heat from the sun, absorbs part of it and reflects a part back to space. These gases effectively reduce the amount that would normally be reflected back. This is called the greenhouse effect. This is the threats induced by human pursuits for growth. Climate change is human-induced coming from the buildup of Green House Effect including Carbon Dioxide, Methane, nitrous oxide and some other industrial chemicals. There has never been a global economic problem as complicated as climate change. It is simply the toughest public policy problem that humanity has ever faced which has covered the entire globe.

(7) Acid Rain

The gaseous compound emerged by environmental disturbances reacts with water vapour to form dilute Sulphuric Acid. This acid then falls to earth in droplets known as acid rain. The increase in the acid can cause great harm to vegetation and fish.

(8) Decline of Biodiversity

Biodiversity refers to the variety of plant and animal life on the planet. The importance of the number of species has come to be recognized only recently through the study of genetics. Species of animals and plants and other creatures depend on each other and are connected with the food chain. Biodiversity loss occurs when entire species are wiped out of existence, thereby breaking some delicate link in a chain that may be vital to others. Biodiversity loss occurs by the destructions of the natural habitat a particular species may fail to adapt to an alternative habitat or to migrate so that the entire species may become extinct. Direct harvesting causes biodiversity loss for human beings resort to slaughter of naturally occurring species for food and pleasure.

Conclusion

In this lecture we discussed and examined the inter cases of ecosystem and ecology. The subject matter is inter-linkages between the two systems. They are interwoven and interdependent and tied with complex relationships. They explain each other and are complementary in nature. The living, non-living and different species on our planet are mutual and exclusive by their nature and existence. But we can neither explain them exclusively from social perspective. We need to synthesize the two and doing so we get Trans disciplinary discipline which incorporate them together. The important thing to understand is that when these two systems are perturbed or distracted by environmental problems than they have far reaching natural, social and economic consequences. Hence the message is clear that ‘natural set up’ on planet should be maintained and if it is disturbed, appropriate policy should be designed to gain the balance.