Global Environmental Issues

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Understand the effects of ozone layer depletion
- ✓ Discuss the impacts of global warming and its implications

Global Environmental Issues

Introduction

An environmental problem arises whenever there is a change in the quality or quantity of any environmental factor which directly or indirectly affects the health and well-being of man in an adverse manner. Environmental problems can be studied from two different viewpoints. One is simply to look for adverse effects without regard to their origin in order to detect trends that call for further investigation; the other is to try to understand the cause and effect relationships, which make better prediction and proper management possible.

Some of the environmental issues which are critical at the present time are fairly widely known because of the growing awareness of all levels of society, including governments, general public and the scientific community. However, our present information on the structure and function of the biosphere is not sufficient to allow an accurate evaluation of the total situation, expect to indicate some broad problem areas. There may be serious potential problems of which we are as yet unaware; other known problems may be less serious than we think.

Global Environmental Issues

As early as 1896, the Swedish scientist Svante Arrhenius had predicted that human activities would interfere with the way the sun interacts with the earth, resulting in global warming and climate change. His prediction has become true and climate change is now disrupting global environmental stability. The last few decades have seen many treaties, conventions, and protocols for the cause of global environmental protection.

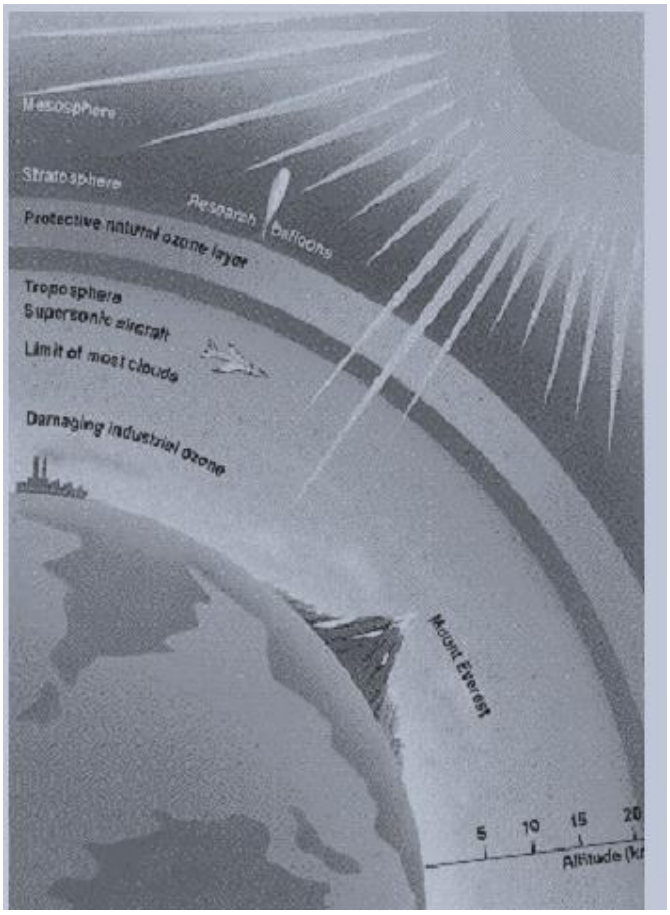
Few examples of environmental issues of global significance are:

- Ozone layer depletion
- Global warming
- Loss of biodiversity

One of the most important characteristics of this environmental degradation is that it affects all mankind on a global scale without regard to any particular country, region, or race. The whole world is a stakeholder and this raises issues on who should do what to combat environmental degradation.

Ozone Layer Depletion

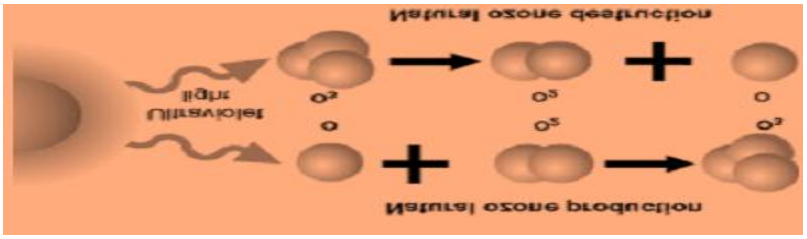
Earth's atmosphere is divided into three regions, namely troposphere, stratosphere and Mesosphere. The stratosphere extends from10 to 50 kms from the Earth's surface. This region is concentrated with slightly pungent smelling, light bluish ozone gas. The ozone gas is made up of molecules each containing three atoms of oxygen; its chemical formula is O3. The ozone layer, in the stratosphere acts as an efficient filter for harmful solar Ultraviolet B (UV-B) rays.



1.1

Ozone is produced and destroyed naturally in the atmosphere and until recently, this resulted in a well balanced equilibrium.

Ozone is formed when oxygen molecules absorb ultraviolet radiation with wavelengths less than 240 nanometres and is destroyed when it absorbs ultraviolet radiation with wavelengths greater than 290 nano metres. In recent years, scientists have measured a seasonal thinning of the ozone layer primarily at the South Pole. This phenomenon is being called the ozone hole.



1.2 Ozone production and destruction process

Effects of Ozone Layer Depletion

Effects on Human and Animal Health: Increased penetration of solar UV-B radiation is likely to have high impact on human health with potential risks of eye diseases, skin cancer and infectious diseases.

Effects on Terrestrial Plants: In forests and grasslands, increased radiation is likely to change species composition thus altering the bio-diversity in different ecosystems. It could also affect the plant community indirectly resulting in changes in plant form, secondary metabolism, etc.

Effects on Aquatic Ecosystems: High levels of radiation exposure in tropics and subtropics may affect the distribution of phytoplanktons, which form the foundation of aquatic food webs. It can also cause damage to early development stages of fish, shrimp, crab, amphibians and other animals, the most severe effects being decreased reproductive capacity and impaired larval development.

Effects on Bio-geo-chemical Cycles: Increased solar UV radiation could affect terrestrial and aquatic bio-geo-chemical cycles thus altering both sources and sinks of greenhouse and important trace gases, e.g. carbon dioxide (CO2), carbon monoxide (CO), carbonyl sulfide (COS), etc. These changes would contribute tobiosphere-atmosphere feedbacks responsible for the atmosphere build-up of these greenhouse gases.

Effects on Air Quality: Reduction of stratospheric ozone and increased penetration of UVB radiation result in higher photo dissociation rates of key trace gases that control the chemical reactivity of the troposphere. This can increase both production and destruction of ozone and related oxidants such as hydrogen peroxide, which are known to have adverse effects on human health, terrestrial plants and outdoor materials.

The ozone layer, therefore, is highly beneficial to plant and animal life on earth filtering out the dangerous part of sun's radiation and allowing only the beneficial part to reach earth.

Any disturbance or depletion of this layer would result in an increase of harmful radiation reaching the earth's surface leading to dangerous consequences.

Ozone Depletion Counter Measures

- International cooperation, agreement (Montreal Protocol) to phase out ozone depleting chemicals since 1974
- Tax imposed for ozone depleting substances
- Ozone friendly substitutes- HCFC (less ozone depleting potential and shorter life)
- Recycle of CFCs and Halons

Global Warming

Before the Industrial Revolution, human activities released very few gases into the atmosphere and all climate changes happened naturally. After the Industrial Revolution, through fossil fuel combustion, changing agricultural practices and deforestation, the natural composition of gases in the atmosphere is getting affected and climate and environment began to alter significantly.

Over the last 100 years, it was found out that the earth is getting warmer and warmer, unlike previous 8000 years when temperatures have been relatively constant. The present temperature is 0.3 - 0.6 ^{o}C warmer than it was 100 years ago.

The key greenhouse gases (GHG) causing global warming is carbon dioxide. CFC's, even though they exist in very small quantities, are significant contributors to global warming.Carbon dioxide, one of the most prevalent greenhouse gases in the atmosphere, has two major anthropogenic (human-caused) sources: the combustion of fossil fuels and changes in land use. Net releases of carbon dioxide from these two sources are believed to be contributing to the rapid rise in atmospheric concentrations since Industrial Revolution.Because estimates indicate that approximately80 percent of all anthropogenic carbon dioxide emissions currently come from fossil fuel combustion, world energy use has emerged at the center of the climate change debate.

Global Warming (Climate Change) Implications

Rise in Global Temperature

Observations show that global temperatures have risen by about 0.6 °C over the 20th century. There is strong evidence now that most of the observed warming over the last 50 years is caused by human activities. Climate models predict that the global temperature will rise by about 6 °C by the year 2100.

Rise in Sea Level

In general, the faster the climate change, the greater will be the risk of damage. The mean sea level is expected to rise 9 - 88 cm by the year 2100, causing flooding of low lying areas and other damages.

Food Shortages and Hunger

Water resources will be affected as precipitation and evaporation patterns change around the world. This will affect agricultural output. Food security is likely to be threatened and some regions are likely to experience food shortages and hunger.

Loss of Biodiversity

Biodiversity refers to the variety of life on earth, and its biological diversity. The number of species of plants, animals, micro organisms, the enormous diversity of genes in these species, the different ecosystems on the planet, such as deserts, rainforests and coral reefs are all a part of a biologically diverse earth. Biodiversity actually boosts ecosystem productivity where each species, no matter how small, all have an important role to play and that it is in this combination that enables the ecosystem to possess the ability to prevent and recover from a variety of disasters.

It is now believed that human activity is changing biodiversity and causing massive extinctions. The World Resource Institute reports that there is a link between biodiversity and climate change. Rapid global warming can affect ecosystems chances to adapt naturally.

Over the past 150 years, deforestation has contributed an estimated 30 percent of the atmospheric build-up of CO2. It is also a significant driving force behind the loss of genes, species, and critical ecosystem services.

Link between Biodiversity and Climate change

- Climate change is affecting species already threatened by multiple threats across the globe. Habitat fragmentation due to colonization, logging, agriculture and mining etc., are all contributing to further destruction of terrestrial habitats.
- Individual species may not be able to adapt. Species most threatened by climate change have small ranges, low population densities, restricted habitat requirements and patchy distribution.
- Ecosystems will generally shift northward or upward in altitude, but in some cases they will run out of space – as 1 ^{o}C change in temperature correspond to a 100 Km change in latitude, hence, average shift in habitat conditions by the year 2100 will be on the order of 140 to 580 Km.
- Coral reef mortality may increase and erosion may be accelerated. Increase level of carbon dioxide adversely impact the coral building process (calcification).
- Sea level may rise, engulfing low-lying areas causing disappearance of many islands, and extinctions of endemic island species.
- Invasive species may be aided by climate change. Exotic species can out-compete native wildlife for space, food, water and other resources, and may also prey on native wildlife.
- Droughts and wildfires may increase. An increased risk of wildfires due to warming and drying out of vegetation is likely.
- Sustained climate change may change the competitive balance among species and might lead to forests destruction

Potentially Adverse Changes on Biota and Man from Contamination by Toxic Substances including Radio nuclides

This is one of the most complex and widespread of the environmental problems because many potential contaminants are involved, with the list growing each year, and immense number of species that could be affected. Many cases of local catastrophes or widespread poisoning in man and wildlife have already occurred.

The more hazardous toxic substances include heavy metals (lead, mercury and cadmium), organ chlorine compounds (DDT, its degradation products and metabolites, polyc Worinated biphenyls) and possibly petroleum products. Contamination occurs in all media: air, land, water and biota. Of particular importance, however, are those parts of the biosphere where the substances show long residence times, namely in soils and sea water. The sea is the ultimate repository of almost every kind of pollutant material created by man. Industrial effluents and biocides are discharged directly into coastal waters or carried to the sea by rivers. Toxic materials are often dumped in quantity on the seabed or into the open waters of the oceans. Hazardous cargoes, transported by ships as freight or fuel, are released either by accident or design into the sea. Pollutants transported by the atmosphere are continuously transferred by precipitation or direct diffusion onto the surface waters.

The use of the biosphere as a recipient for toxic and other waste products will inevitably affect animal and plant species, their growth and reproduction. Every kind of pollutant in some measure affects the character of an ecosystem structure by decreasing the species diversity. Toxic substances may endanger man's health directly or by passage and accumulation through food chains.

The effects of contaminants on biota can be studied by considering various biological effects, such as changes in the numbers and distribution ranges of organisms, changes in the structure of plant and animal communities, replacements of whole ecosystems and changes in productivity. Thus, by assessing selected parameters which describe changes in single species or biological systems of higher order, both specific and general effects on biota can be determined.

Important changes in many species populations, including extinctions, are well-known. Inadvertent or deliberate simplifications of ecosystems with a resulting decrease in stability and tolerance of environmental stress have occurred many times. The transfer of natural ecosystems to monoculture agricultural systems constitute the best examples of ecosystem simplification which now need continuous management to preserve the desired state. In some cases whole ecosystems have been completely replaced by new ones because of intensive pollution or grazing by domestic animals. Possible adverse effects on agricultural productivity are of special concern because any factor that tends to decrease the production of food and fiber must receive a high priority in the monitoring system. To arrive at the optimal combination of exploitation and management of natural resources, programmes must be developed that provide continuous information on the use of these resources and permit evaluation of the consequences of predicted future developments.

In contrast to the above problems, monitoring of radioactive contaminants is currently being efficiently provided by UNSCEAR, IAEA and other agencies. Thus, it is not anticipated that any new programmes, other than support of the current effort, will be necessary for this very important problem. In the future, however, the predicted growth of nuclear powered electrical generating plants will necessitate greater awareness of the potential hazards from storage of radioactive wastes.

Potentially Adverse Changes in Biological Productivity Caused by Improper Land-use

The land surface in extensive parts of the world is changing because of the intense agricultural methods necessary to provide for a growing population with an increasing per capita consumption. In many parts of the world, improper land use has resulted in irreversible degradation of soils and vegetation. Soil erosion by wind and water, leaching of nutrients and extension of arid zones have been caused by such improper land-uses as overgrazing in arid zones, deforestation in areas with unstable soils and over-use of both surface and ground-water resources.

Usually, these problems are local or regional in nature and are the responsibility of individual governments. However, because similar changes in soil fertility have occurred throughout the world in many nations, a global, multi-governmental approach to the problem is appropriate. Moreover, because the local effects of decreased soil fertility may be very significant, the economy of adjacent regions may

also be affected. Extension of arid zones can also induce large-scale climatic changes by allowing considerable amounts of windblown dust to become airborne.

Potentially Adverse Changes in the Growth, Structure and Distribution of the Human Population

The fast growth of the human population in combination with changes in its distribution pattern, particularly the strong and increasing tendency towards urbanization, constitutes one of two major factors responsible for the creation of environmental problems; the other being technological developments. Among the variety of environmental problems that are affected by population growth and urbanization are: over-utilization of land; deterioration of natural areas; ecological changes; depletion of natural resources; dietary deterioration; increase of urban pathology; increased wastes; and the consequences of national policies to reduce or increase fertility.

We are satisfied that the United Nations will continue to improve its already valuable collection and evaluation of information on population size, vital statistics and demographic data which will provide supporting information both to the environmental monitoring system and to other international and national activities, particularly those related to human health monitoring.

Changes in the Subjective Human Perception of the Environment

Changes of the environment may or may not be harmful to man. However, both kinds of change maybe perceived by people annoying, dangerous or even irrelevant. This not only applies to laymen, but also to environmental scientists, planners and decision makers. Consequently the subjective perception of environmental problems constitutes an important factor in relation to environmental monitoring activities. It may serve as a kind of qualitative evaluation of the results of control management.

Eutrophication of Waters

Both natural and man-made lakes have suffered from eutrophication and its secondary effects. In lakes receiving nitrogen and phosphorus compounds and other agricultural fertilizers, unprecedented blooms of algae have occurred. The algae themselves can spoil water quality and recreational conditions. When they die and decay, the oxygen demand may exceed the supply with resultant fish kills. The average oxygen content of some fresh water bodies has decreased very markedly in historic times. The effects of added nutrients on marine life are not well known but there may be particularly important synergistic effects, for example, if the oxidation of oil in the sea is biologically controlled. Fertilization of the seas may enhance the production of directly economically valuable species .Because eutrophication is primarily a local problem; it has not been included in the global environmental monitoring system.

Decreasing Freshwater Resources

The availability to man of freshwater of high quality is becoming an acute problem in many countries. Water requirements continue to increase with the growth of populations and living standards and the expansion of agriculture and industry. Water is needed for power generation irrigation, navigation and community water supply. Often it is drawn from international rivers or lakes and in many instances

international co-operation is needed in the allocation of water and the financing and technical aspects of water resource development projects. The availability of ground water is most often a local problem but it has international implications in relation to the general effects which a depletion of groundwater may have within a larger region.

Natural Disasters

Although natural disasters constitute a very important environmental problem, it is not pertinent to include a programme directly related to natural disaster monitoring or warning within the global environmental monitoring system. It is appropriate, however, that the system should provide assistance in reporting phenomena that relate to natural disasters.

Climatic Change Problem and Response

The United Nations Framework Convention on Climate Change, UNFCCC

In June 1992, the "United Nations Framework Convention on Climate Change" (UNFCCC) was signed in Rio de Janeiro by over 150 nations. The climate convention is the base for international co-operation within the climate change area. In the convention the climate problem's seriousness is stressed. There is a concern that human activities are enhancing the natural greenhouse effect, which can have serious consequences on human settlements and ecosystems.

The convention's overall objective is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."

The principle commitment applying to parties of the convention is the adoption of policies and measures on the mitigation of climate change, by limiting anthropogenic emissions of greenhouse gases and protecting and enhancing greenhouse gas sinks and reservoirs. The commitment includes the preparation and communication of national inventories of greenhouse gases. The Climate convention does not have any quantitative targets or time tables for individual nations. However, the overall objective can be interpreted as stabilization of emissions of greenhouse gases by year 2000 at 1990 levels.

The deciding body of the climate convention is the Conference of Parties (COP). At the COP meetings, obligations made by the parties are examined and the objectives and Implementation of the climate convention are further defined and developed. The first COP Was held in Berlin, Germany in 1995 and the latest (COP 10) was held in December 2004,Buenos Aires, Argentina.

The Kyoto Protocol

There is a scientific consensus that human activities are causing global warming that could result in significant impacts such as sea level rise, changes in weather patterns and adverse health effects. As it became apparent that major nations such as the United States and Japan would not meet the voluntary stabilization target by 2000, Parties to the Convention decided in 1995 to enter into negotiations on a protocol to establish legally binding limitations or reductions in greenhouse gas emissions. It was decided

by the Parties that this round of negotiations would establish limitations only for the developed countries, including the former Communist countries (called annex A countries).
Negotiations on the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) were completed December 11, 1997, committing the industrialized nations to specify, legally binding reductions in emissions of six greenhouse gases. The 6 major greenhouse gases covered by the protocol are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur xafluoride (SF he 6).

Emissions Reductions

The United States would be obligated under the Protocol to a cumulative reduction in its Green house gas emissions of 7% below 1990 levels for three greenhouse gases (including carbon dioxide), and below 1995 levels for the three man-made gases, averaged over the commitment period 2008 to 2012.

The Protocol states that developed countries are committed, individually or jointly, to ensuring that their aggregate anthropogenic carbon dioxide equivalent emissions of greenhouse gases do not exceed amounts assigned to each country with a view to reducing their overall emissions of such gases by at least 5% below 1990 levels in the commitment period 2008 to 2012.

The amounts for each country are listed as percentages of the base year, 1990 and range from 92% (a reduction of 8%) for most European countries--to 110% (an increase of 10%) for
Iceland.

Responsibilities of Developing Countries

Another problematic area is that the treaty is ambiguous regarding the extent to which developing nations will participate in the effort to limit global emissions. The original 1992 climate treaty made it clear that, while the developed nations most responsible for the current buildup of greenhouse gases in the atmosphere should take the lead in combating climate change, developing nations also have a role to play in protecting the global climate.

Developing countries, including India and China, do not have to commit to reductions in this first time period because their per-capita emissions are much lower than those of developed countries, and their economies are less able to absorb the initial costs of changing to cleaner fuels. They have not contributed significantly to today's levels of pollution that has been the product of the developed world's Industrial Revolution. The idea is that developing countries will be brought more actively into the agreement as new energy technologies develop and as they industrialize further.

1.3 sustainable development

Sustainable development demands that we seek ways of living, working and being that enable all people of the world to lead healthy, fulfilling, and economically secure lives without destroying the environment and without endangering the future welfare of people and the planet.

Sustainable development as applied to energy and environment should consider the following:

- inputs - such as fuels and energy sources, land and raw materials - are non-renewable they should be used up only as far as they can be substituted in future
- where they are renewable they should be used up at a rate within which they can be renewed,
- outputs - in production and consumption - should not overstrain ecosystems or the assimilation capacity of the ecosphere.

Further Reading:

- ✓ ***Global Environmental Issues,edited by Frances Harris,(2012)***
- ✓ ***An Introduction to Global Environmental Issues,By Kevin T. Pickering, Lewis A. Owen,(1997)***