UNIT-2

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

Unit 2

Global Environmental Issues

Introduction

Any change in the amount or quality of an environmental factor which can negatively affect, either directly or indirectly, the health or wellbeing of humans is considered an **environmental issue**. There are two ways of investigating an environmental problem. One way is to focus on finding trends in the effects. Another way is to try to work out what caused these effects in the first place. Understanding the cause-and-effect relationships involved in a problem makes better forecasting and management of the situation possible.

Because of increased environmental awareness in all levels of modern society, most of us are familiar with some of the more pressing environmental issues we face today. Unfortunately, we do not yet have enough information about biosphere structures and functions to accurately evaluate the overall situation. Although we are aware of some general problem areas, there may be other serious issues of which we are as yet unaware.

Explanation

As early as 1896, Swedish scientist Svante Arrhenius predicted that human activities would interfere with the way the sun interacts with the earth. Furthermore, he said, this interference would ultimately lead to **global warming** and **climate change**.

His prediction has now come true. Climate change is disrupting the stability of the global environment more and more with each passing year. In response, many treaties, conventions and protocols concerning global environmental protection have been created during the last few decades in order to address the issue.

A few examples of environmental issues of global significance include:

- Ozone layer depletion
- Global warming
- Loss of biodiversity

It is important for us to realize that environmental degradation affects the entire planet and all of its inhabitants, humans included. We are all part of this world and, as such, we all share the responsibility for preserving it. This raises important questions, however, regarding who should be doing what to combat environmental degradation.

The Ozone Layer

Earth's atmosphere is divided into three regions: the **troposphere**, the **stratosphere**, and the **mesosphere**. The stratosphere extends up to 10 to 50 kilometres above Earth's surface. This region contains a pungent, bluish gas concentrated in what is known as the **ozone layer**. Ozone gas is made up of molecules which are each made up of three atoms of oxygen. Thus, its chemical formula is O3. The ozone layer acts as a filter which blocks out harmful solar ultraviolet B, or UVB, rays.

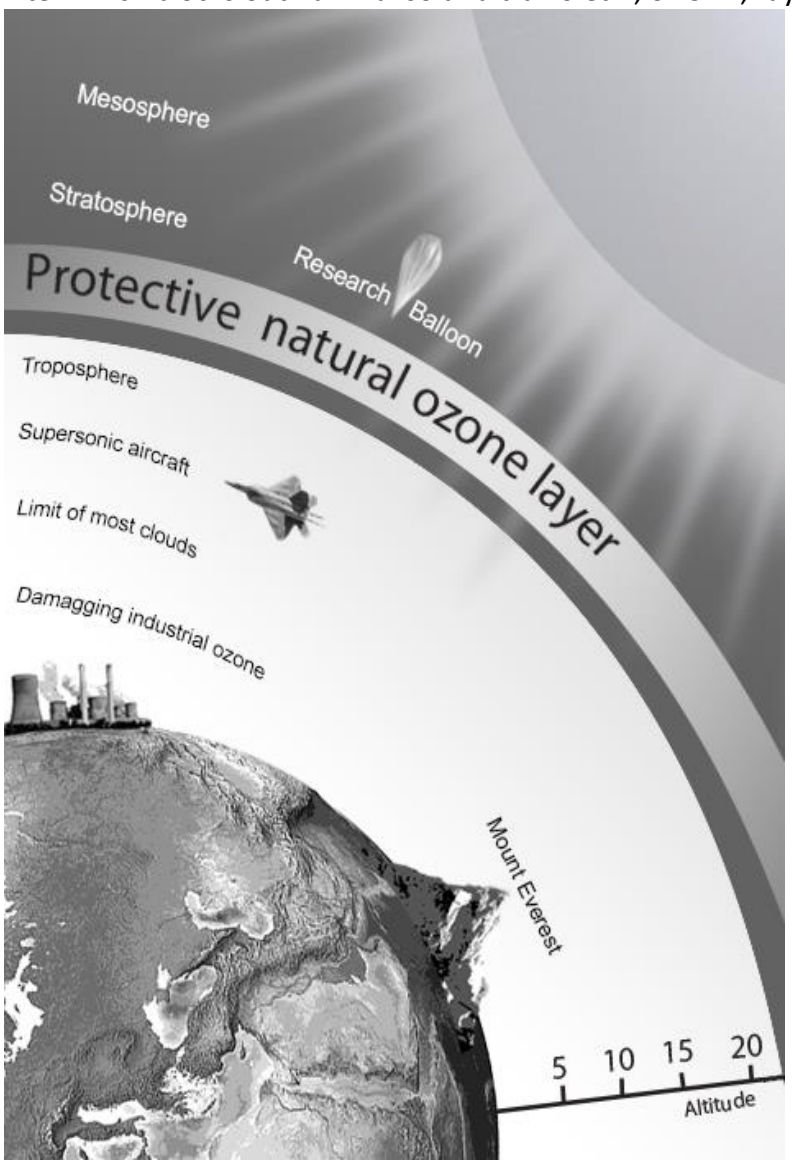

Fig: 2.1: the ozone layer

Ozone is constantly being created and destroyed as part of the natural processes of the atmosphere. It is formed when oxygen molecules absorb ultraviolet radiation with wavelengths of less than 240 nanometres. When it absorbs ultraviolet radiation with wavelengths greater than 290 nanometres, the ozone breaks down. In recent years, scientists have observed a seasonal thinning of the ozone layer which primarily takes place over the South Pole. This area of the ozone layer is called the **ozone hole**.

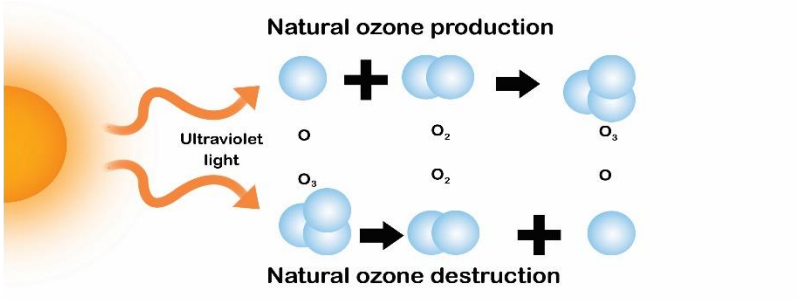

Fig: 2.2: ozone production and destruction cycle

Effects of Ozone Layer Depletion

Effects on Human and Animal Health

Increased penetration of solar UVB radiation is likely to have a huge impact on human health. Potential risks include eye diseases, skin cancers and infectious illnesses.

Effects on Terrestrial Plants

In forests and grasslands, increased radiation is likely to affect species composition. This could drastically change the biodiversity of all sorts of ecosystems. It could also affect the plant community indirectly by causing changes in plant form, metabolism, and more.

Effects on Aquatic Ecosystems

High levels of radiation exposure in tropical and subtropical regions may affect the distribution of phytoplankton, which form the foundation of most aquatic food webs. It could also cause severe damage during the early life cycle stages of various aquatic animals by decreasing reproductive capacity or impairing larval development.

Effects on Biogeochemical Cycles

Increased UV radiation could result in altered sources and sinks of greenhouse gases, as well as other important trace gases such as carbon dioxide (CO2), carbon monoxide (CO), carbonyl sulfide (COS), and more. These changes could create biosphere-atmosphere feedback loops which would result in dangerous buildups of these greenhouse gases.

Effects on Air Quality

Reduction of the ozone layer and increased penetration of solar radiation results in higher photo dissociation rates of the key trace gases which control the chemical reactivity of the troposphere. This, in turn, would increase the rate at which ozone (as well as related oxidants such as hydrogen peroxide) is created and destroyed, which would negatively affect the health of humans, animals and plants alike.

Countermeasures

It is obvious how important the ozone layer is to plant and animal life on earth. It is equally obvious that any impairment to the ozone layer's ability to protect the earth from harmful UVB rays presents a very

real threat to the survival of plants and animals alike. Some countermeasures which can be (and already have been) put in place to allow the layer to heal and to prevent future damage include:

- Creating international cooperation and agreements (such as the Montreal Protocol) to phase out ozone-depleting chemicals. Discussions of such measures have been taking place since 1974
- Imposing taxes or fines for producing and releasing ozone-depleting substances
- Using ozone-friendly substitutes, such as hydro chlorofluorocarbons (HCFCs), which are less harmful to the ozone and quicker to dissipate than other substances
- Recycling chlorofluorocarbons (CFCs) and halons.

Global Warming

In the past, human activity did not generate as much air pollution as it does today. As such, all climate change happened naturally. It was not until the Industrial Revolution that practices such as fossil fuel combustion, deforestation and other innovations in agricultural and urban technologies began to affect the natural composition of the atmosphere.

Earth maintained relatively stable temperatures for nearly 8000 years. It was only within the last century of human history that things began to heat up. Worldwide temperatures today measure 0.3°-0.6°C higher than they did 100 years ago.

CFCs, even though they exist in very small quantities, are big contributors to global warming. The most prevalent greenhouse gas (GHG) of them all, however, is carbon dioxide. CO2 has two anthropogenic, or human-caused, sources: fossil fuel combustion, and changes in land use. Current estimates indicate that about 80% of all anthropogenic (human-caused) carbon dioxide emissions come from fossil fuel combustion alone. As a result, world energy usage is now at the centre of the climate change debate.

Global Warming (Climate Change) Implications

Rise in Global Temperatures

Observations show that global temperatures have risen by about 0.6°C during the course of the 20th century. There is strong evidence now that most of the observed global warming over the last 50 years has been 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

The mean sea level is expected to rise by 9.88 cm by the year 2100. Flooding is just one example of the destruction this will cause. The faster the climate changes, the greater risk there is of damage to the environment.

Food Shortages and Hunger

As the climate changes, so will the weather. In particular, precipitation and evaporation patterns will be affected, and in turn food production will be altered. This is likely to result in food shortages and hunger in various regions.

Loss of Biodiversity

Biodiversity refers to the amount of variety of life in a given region. This might refer to how many different kinds of plants, animals, and microorganisms there are in a given region, as well as how diverse each species is. Having many kinds of life in the same place helps an ecosystem to be both healthier and more productive. The greater the diversity, the more support systems available when disasters occur.

Over the course of history, human activity has led to the mass extinction of multiple species. This, in turn, has affected the biodiversity of many ecosystems, which, according to the research of the World Resource Institute, negatively affects these ecosystems' ability to cope with the rapid progress of global warming. Deforestation in the past 150 years alone has contributed an estimated 30% of the total atmospheric buildup of CO2, in addition to causing the loss of a wide variety of species, specific genes, and important natural processes.

Links between Biodiversity and Climate Change

The negative effects of climate change present yet more dangers to species across the globe, which are already facing numerous other threats, including habitat loss due to colonization, logging, agriculture, mining, and more.

In addition, certain species may not be able to adapt to the rapid changes caused by global warming. Species with limited diversity, low population density, specific habitat requirements, and patchy distribution are those most at risk. Coral reefs, in particular, are at high risk of both mortality and erosion. Increased levels of CO2 have also impaired reefs' abilities to calcify, or build coral.

On the other hand, populations of certain invasive species may thrive under the same conditions that weaken and kill the native plants and animals of an ecosystem. These invasive species will then compete with other organisms in the region for resources, slowly taking over as the native species begin to die out. This further disrupts the balance and overall health of an ecosystem.

To cope with global warming, ecosystems often shift northwards or up to higher altitudes. However, space is limited – for some, there will not be enough to move. A temperature change as small as 1°C corresponds to a 100-kilometre change in latitude. At the rate at which current temperatures are rising, ecosystems will have to move a total of 140 to 580 km in order to survive.

Moreover, as increased temperatures cause glaciers to melt and sea levels to rise, many low-lying islands (and the numerous species which call these islands home) will disappear beneath the waves. At the same time, the higher temperatures will dry out inland ecosystems, increasing the risk and frequency of droughts and wildfires.

Negative Effects of Toxic Contamination

Pollution can be found everywhere: the air, the land, the sea, even in living organisms. Local catastrophes and incidents of poisoning in both human and animal life have occurred time and time again. This widespread contamination, combined with the huge variety of contaminants (a list that grows longer every year), makes **toxic contamination** one of the most complicated environmental problems on Earth.

The most hazardous toxic substances include heavy metals (lead, mercury and cadmium), chlorine compounds (DDT and its products, polychlorinated biphenyls), and petroleum products. The worst cases of contamination occur in media where contamination and its effects last longest: in dirt and in water. Nearly every man-made contaminant on Earth ends up in the ocean. Industrial effluents and biocides are discharged directly into coastal waters or carried to the sea by rivers. Large amounts of toxic materials are often dumped onto 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. Even air pollution may be transferred to the ocean by way of precipitation or more direct transmission.

Toxic contamination poses a great threat to the growth and reproduction of both animals and plants. Every kind of pollutant can harm the biodiversity of an ecosystem, and most also endanger the health of humans either directly or through consumption of contaminated organisms.

The effects of contamination 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, and changes in productivity, as well as the way in which whole ecosystems are sometimes replaced.

Most of us are familiar with concepts such as endangered or extinct species. Accidental or deliberate simplifications of ecosystems generally result in a loss of stability and stress tolerance in those environments. There are many ecosystems which have been so oversimplified in this manner that they now require continuous management in order to be preserved.

In some cases, entire ecosystems have collapsed and been replaced in the wake of intensive pollution or over-grazing by domestic animals. Cases in which this might negatively affect agricultural productivity are of particular concern. In order to find a good balance between the consumption and preservation of natural resources, we need to both educate the public on the management of these resources and regularly evaluate the consequences of any future changes we predict.

Happily, monitoring of radioactive contaminants is currently provided by UNSCEAR, IAEA and other agencies. However, the predicted growth of nuclear power usage suggests that in the future we will need to increase public awareness of the potential hazards that could result from storing radioactive waste.

Possible Negative Effects of Improper Land Use

An ever-growing population with an increasing per capita consumption of food and drink has taken a toll on the earth's surface. In regions around the world, **improper land use** such as the overgrazing of arid zones, the deforesting of areas with unstable soil, and the overuse of both surface and ground-water resources has permanently damaged both land and vegetation by increasing soil erosion, depleting nutrients and extending arid zones.

Usually, these problems are local or regional in nature and are therefore the responsibility of individual governments. However, similar changes in soil fertility have occurred throughout the world in many countries. Where soil fertility is significantly decreased, the economy of adjacent regions may suffer, and

the greater the extension of the arid zones, the more airborne the dust will become. Hence, a global, multi-governmental approach to the issue would be a more appropriate way of proceeding.

Eutrophication of Waters

Eutrophication is a type of pollution in which a high volume of nutrients is suddenly deposited into a body of water. Natural and man-made lakes alike have suffered from both primary and secondary effects of eutrophication, such as the introduction of algae. Algae spoils water quality, and when it begins to die and decay, it can be deadly to fish.

The effects of extra nutrients on marine life are not well-known, but there may be important synergistic effects. For instance, the average oxygen content of some freshwater areas has decreased markedly in the past. If the oxidation of the oil in the sea is biologically controlled, fertilization may enhance the production of certain economically valuable species.

However, because eutrophication is primarily a local problem, it has not been included in the global environmental monitoring system.

Decreasing Freshwater Resources

The decreasing availability of high-quality freshwater has become a serious problem in many countries. Increasing populations, improved living standards, and an expanding agriculture industry have resulted in increased demand for water. Water is needed for power generation, irrigation, navigation and, of course, for drinking. Often, it is drawn from international rivers or lakes. In many instances, international cooperation is required for the financial and technical aspects of water collection and the maintenance of water resource development projects. Although seemingly a local problem, the unavailability of groundwater can have widespread negative effects.

Natural Disasters

Although natural disasters are also an important issue, creating a system directly related to natural disaster monitoring is not currently a priority. However, it is important for the global environmental monitoring system to provide assistance in reporting phenomena related to any natural disasters that may occur.

Negative Effects on the Human Population

The vast growth and spread of the human population, combined with a tendency to urbanization and technological advancement, has played a major role in creating the environmental issues we now face. These factors have resulted in an overuse of land, depletion of natural resources, increased waste production, habitat destruction, and more.

Encouragingly, the United Nations continues to improve the way it collects and evaluates important data on population size, vital statistics, and other demographic data, information which will in turn help us monitor the health of both the environment and the human population on national and international scales.

Climatic Change Problem and Response

Whether we see changes in the environment as dangerous, merely annoying, or even irrelevant affects our response to these changes. Therefore, our perception of environmental issues – in particular, how important they are to us – is an important factor in how we monitor our environment.

The United Nations Framework Convention on Climate Change

In June 1992, the **United Nations Framework Convention on Climate Change (UNFCCC)** was signed in Rio de Janeiro by more than 150 nations, setting a new standard for international cooperation relating to climate change. The UNFCCC stresses the seriousness of climate change and mankind's contribution to it, as well as the worldwide consequences of global warming.

The overall objective of the conference was to stabilize greenhouse gas concentrations in the atmosphere at safe levels. In particular, the UNFCCC called for the adoption of policies and measures to limit anthropogenic emissions of GHGs while protecting GHG sinks and reservoirs. While there were no specific targets or timetables set for individual nations, the original goal was to reduce GHG emission levels back to where they were in 1990 by the year 2000.

The decision-making body behind the UNFCCC was the Conference of Parties, or COP. At COP meetings, each attending party's obligations were examined, and the objectives and requirements of the Convention were defined and developed as needed. The first COP was held in Berlin, Germany in 1995. The tenth and last COP was held in December of 2004 in Buenos Aires, Argentina.

The Kyoto Protocol

Once it became apparent that several major nations, including the United States and Japan, would not meet the voluntary stabilization target by 2000, negotiations began to create a protocol that would establish legally-binding restrictions and reductions in GHG emissions. It was decided that these limitations would only apply to developed countries.

Negotiations regarding the **Kyoto Protocol** for the UNCCC were completed on the 11th of December, 1997. The Protocol named six specific GHGs, the emission of which industrial countries would have to limit and reduce: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF 6).

The Kyoto Protocol called for the US in particular to reduce emissions to 7% below 1990 levels for three of the named GHGs (including CO_2), and to reduce the emissions of the three man-made gases to below 1995 levels, between the years 2008 and 2012.

The Protocol states that developed countries are committed, individually or jointly, to ensuring that their total GHG emissions do not exceed the amount that is legally allowed by the Protocol, in order to ensure that overall emissions will be reduced to 5% below 1990 levels between 2008 and 2012. The amounts for each country are listed as percentages established on the base year (199) and range from 92% (indicating a reduction of 8%) in most European countries, to 110% (indicating an increase of 10%) in Iceland.

Responsibilities of Developing Countries

One problem with the Kyoto Protocol is its ambiguity about the extent to which developing countries must participate in the effort to limit global GHG emissions. The original UNFCCC made it clear that, while industrial nations should take the lead in combating climate change, developing nations would need to play their part as well.

Developing countries such as India and China did not have to commit to reductions during the period 2008-2012 because their per capita emissions were much lower than those of developed countries and because their economies could not easily cope with the cost of switching to cleaner fuels. However, developing countries will be expected to play more active roles in the fight against global warming in the future as these countries become more industrialized and new, more affordable and efficient energy technologies are created.

Fig: 2.3: sustainable development

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

When pursuing sustainable development, we need to consider the following:

- Non-renewable resources are a limited supply. They will need to be replaced by alternative, renewable resources in the near future.
- Renewable resources must not be consumed at a faster rate than they can be renewed.
- Production and consumption must not be allowed to overwhelm or put undue strain on any ecosystem or its capacity for assimilation.

Further Reading:

- ✓ ***Earth Detox: How and Why we must clean up our Planet, (2021), By Julian Cribb***
- ✓ ***Global Environmental Issues, (2016),* edited by Frances Harris**

