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Topic : Global Environmental Issues and Management

Commissioner,

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GLOBAL ENVIRONMENTAL ISSUES AND MANAGEMENT

CLIMATE CHANGE: GLOBAL ENVIRONMENTAL ISSUES

GLOBAL ENVIRONMENTAL ISSUES:

1.Climate Change:

Climate change is a change in usual weather found in place. This could be a change in how much rain in a place usually gets in a year or it could be a change in a place usual temperature for a month or season. Climate change is also a change in earth climate. This could be a change in where rain and snow usually fall on earth.

Changes in climate on earth:

Earth climate is always changing. There have been times when earth climate has been warmer than it is now. There have been times when it has been cooler. These times can last thousands or millions of years. People who study earth see that earth's climate is getting warmer. Earth's temperature has gone up about one Degree Fahrenheit in the last 100 years. This may not see much like much. But small changes in Earth's temperature can have big effects. The warming earth climate has caused some snow and ice to melt. The warming also has caused oceans to rise and it has changed the timing of when certain plants grow.

Causes of climate change:

Climate change caused may be human activities or nature of its own.

2.Global Warming:

Earth has warmed at an unprecedented rate over the last 100 years and particularly last two decades. An upsurge in the amount of extreme weather events, such as wildfires, heatwaves, and tropical storms. This is particularly because of the global warming.

Global warming is increase in the earth average surface temperature due to effect of greenhouse gases, such as carbon dioxide emissions from burning of fossil fuels or from deforestation which trap heat that would otherwise escape from earth. This is a type of greenhouse effect.

Global warming impacts:

1. Rise in sea level
2. Changed in rainfall pattern
3. Increased likelihood of extreme events such as heatwave, flooding, hurricane etc.
4. Melting of ice caps, glaciers,
5. Widespread Vanishing of animal populations due to habitat loss.
6. Spread of disease like malaria etc..,
7. Bleaching of coral reefs
8. Loss of plankton due to warming of seas.

3.Greenhouse Effect

The greenhouse effect is a process (similar to green house) caused by greenhouse gases, which occur naturally in the atmosphere. This process plays a crucial role in warming the Earth's surface, making it habitable. However, human-generated greenhouse gas emissions upset the natural balance and lead to increased warmth.

Incoming energy:

The Sun emits energy that is transmitted to Earth. Because the Sun is very hot, the energy is emitted in high energy short wavelengths that penetrate the Earth's atmosphere.

Absorption

About 30% of the Sun's energy is reflected directly back into space by the atmosphere, clouds, and surface of the Earth. The rest of the Sun's energy is absorbed into the Earth's system.

Emission

The Earth re-emits energy back into the atmosphere Because the Earth is cooler than the Sun, the energy is emitted in the form of infrared radiation, at wavelengths longer than the incoming solar energy.

Role of Greenhouse Gases

Greenhouse gases in the atmosphere absorb much of the long-wave energy (infrared radiation) emitted from the Earth's surface, preventing it from escaping from the Earth's system. The greenhouse gases then re-emit this energy in all directions, warming the Earth's surface and lower atmosphere.

Human Role

The atmospheric concentration of greenhouse gases has increased significantly over the past two centuries, largely due to human-generated carbon dioxide emissions from burning fossil fuels, deforestation. This increase has amplified the natural greenhouse effect by trapping more of the energy emitted by the Earth. This change causes Earth's surface temperature to increase.

Greenhouse gases

Greenhouse gases means those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorbs and re-emit infrared radiation.

1.Water Vapour
2.Carbon Dioxide
3. Methane
4. Nitrous Oxide
5. Fluorinated Gases
6. Black Carbon
7. Brown Carbon

4.Deforestation

Deforestation is the destruction of forests in order to clear the land and make it available for other uses. Forests cover about 30 percent of the world's landmass. But due to deforestation it is estimated that the earth loses 18.7 million acres of forests per year. In 2016, global tree cover loss reached a record of 29.7 million hectares. Common methods of deforestation are burning trees and clear cutting.

People's Participation in Conservation of Forests People's participation is vital in forest conservation, especially those living in the or close to the forest. This is referred to as Community forestry, which varies widely in legal, political and cultural settings and the term covers a wide range of experiences and practices.

The Bishnois, who are known conservators of their forest, were inspiration to many people's participatory movements for Environmental protection in India. The Chipko movement resisted the destruction of forests of India in the 1970s.Sunderlal Bahuguna was the leader of this movement. People in the movement hugged the trees, and prevented felling of trees by contractors.The 'Forest man of India', Jadav Payeng who created 1,360 acres of dense and defiant forest was born in Aruna sapori (a river island on Brahmaputra).

5.Ocean acidification

The uptake of atmospheric carbon dioxide by the ocean increases, the concentration of hydrogen ions in the ocean increases, the concentration of carbonate ions decreases, the pH of the oceans decreases and the oceans become less alkaline – this process is know as ocean acidification.

Effect of ocean acidification

Seawater absorbs CO_2 to produce carbonic acid (H_2CO_3),bicarbonate (HCO_3--) and carbonate ions (CO_{32}-).These carbonate ions are essential to the calcification process that allows certain marine organisms to build their calcium carbonate shells and skeletons (e.g. hard tropical corals, cold water corals, molluscs, crustaceans, sea urchins, certain types of plankton, lobsters, etc).However, increases in atmospheric CO_2 levels lead to decrease in pH level, increase in the concentration of carbonic acid and

bicarbonate ions, causing a decrease in the concentration of carbonate ions. Thus carbonate ions are less available and calcification is therefore harder to achieve, and may be prevented altogether.

Mitigation

1. Reducing CO_2
2. Promoting government policies to cap CO_2 emissions,
3. Eliminate offshore drilling,
4. By advocating for energy efficiency and
5. Alternative energy sources such as wind power, solar, etc.

6.Ozone Depletion

At about 15 and 30 kilometers from the ground level, the earth's atmosphere has a thin layer of ozone, which absorbs ultraviolet sunlight. Ozone is found in the layer of the atmosphere called the Stratosphere. It acts as a protective covering that absorbs ultraviolet (UV) radiation from the sun. The ozone molecule (O3) consists of three oxygen atoms. It is formed when atmospheric oxygen (O2) on exposure to solar radiation breaks into two oxygen atoms; each atom then joins up with a single oxygen atom. The ozone molecule is unstable. It soon decays again to form molecular oxygen. This cycle is a continuous process in the upper reaches of the stratosphere.

Change in equilibrium

The equilibrium between the formation and destruction of ozone, has been upset by the influx of several substances in to the atmosphere which react with ozone and destroy it.

The rate at which ozone is being destroyed is much faster than the rate at which it is being formed.

It implies that there is a significant decrease in the concentration of the atmosphere hence the name 'ozone depletion'.

Causes and effects of ozone layer depletion

Causes:

Ozone layer depletion mainly occurs by anthropogenic actions.

The excessive release of chlorine and bromine from man-made compounds such as chlorofluorocarbons (CFCs) causes ozone layer depletion. CFCs, methyl chloroform, carbon tetrachloride, hydrochlorofluorocarbons, hydro bromo fluorocarbons and methyl bromide are found to have direct impact on the depletion of the ozone layer. These are categorized as ozone-depleting substances (ODS).

Effects:

1. UV rays may penetrate deep into the skin and can lead to premature skin aging and wrinkling of skin;
2. suppression of the immune system, skin cancer (melanoma) and chronic effects leading to eye damage.
3. DNA damage can result from free radicals and reactive oxygen and photons can damage the DNA itself.

Control:

Ozone layer depletion can be controlled by

(1) Phase down or ban the use of CFCs (CFC free refrigerants).
(2) Minimizing the use of chemicals such as halons and halocarbons.
(3) Creating awareness about ozone depleting agents.

Monitoring the Ozone Layer

Some organizations that help in monitoring the atmosphere and form a network of information communication about the atmosphere, including ozone layer monitoring are:

1. World Meteorological Organization (WMO)
2. World Weather Watch (WWW)
3. Integrated Global Ocean Services Systems (IGOSS)
4. Global Climate Observing System (GCOS)

Role of polar stratospheric clouds in ozone depletion.

There are three types of stratospheric clouds. They are:

1. Nacreous clouds extend from 10 to 100km in length and several kilometers in thickness. They are also called 'mother-of-pearl' clouds due to their glow with a seashell like iridescence.

2. The second type of clouds contain nitric acid instead of pure water.

3. The third type of clouds have the same chemical composition as nacreous clouds, but form at a slower rate, which results in a larger cloud with no iridescence. The chlorine released by the breakdown of CFCs exists initially as pure chlorine or as chlorine monoxide (active chlorine / instable) but these two forms react further to form compounds Chlorine nitrate and HCL that are stable(inactive chlorine).

Why is the Ozone Depletion pre-dominant at the Antarctic?

The Antarctic stratosphere is much colder. The low temperature enables the formation of Polar stratospheric Clouds (PSCs), below 20 km.

Ozone absorbs sunlight, causing the characteristic increase in temperature with increase in altitude in the stratosphere. If ozone is being depleted, the air becomes cooler, further adding to the favorable conditions for the formation of PSCs and stabilization of the vortex.

The vortex is a ring of rapidly circulating air that confines the ozone depletion in the Antarctic region. The longevity of the Antarctic vortex is another factor, enhancing favorable conditions for the depletion of ozone. The vortex remains, in fact, throughout the polar winter, well into midspring whereas the vortex in the Arctic disintegrates by the time the polar spring (March-April) arrives.

Typical happenings in the winter months leading to the Ozone Depletion over the Antarctic. In June Antarctic winter begins, the vortex develops and the temperature falls enough for the clouds to form.

During July and August PSCs denitrify and dehydrate the stratosphere through precipitation, hydrochloric acid and chlorine nitrate react on cloud surfaces to free chlorine and winter temperatures drops to their lowest point.

In September sunlight returns to the centre of the vortex as the austral spring begins and PSCs disappear because of increasing temperature. ClO-ClO and ClOBrO catalystic cycles destroy ozone. During October lowest levels of ozone are reached. In November, Polar vortex breaks down, ozone-rich are from the mid-latitudes replenishes the Antarctic stratosphere and ozone-poor air spreads over the southern hemisphere.

Effect of Ozone depletion:

1.Environmental Effects of Ozone Depletion

1. Decrease in the quantity of total-column ozone; tend to cause increased penetration of solar UV-B radiation(290-315nm) to the earth's surface.
2. UV-B radiation is the most energetic component of sunlight reaching the earth's surface.
3. It has profound effects on human health, animals, plants, micro-organisms, materials and on-air quality.

2.Effects of human and animal health

1. Potential risks include an increase in the incidence of and morbidity from eye diseases, skin cancer and infectious diseases.
2. UV radiation has been shown in experimental systems to damage the cornea and lens of the eye. Experiments in animals show that UV exposure decreases the immune response to skin cancers, infectious agents and other antigens and can lead to unresponsiveness upon repeated challenges.
3. In susceptible (light-skin coloured) populations, UV-B radiations is the key risk factor for development of non-melanoma skin cancer (NMSC).

Effects on terrestrial plants

1. Psychological and developmental processes of plants are affected by UV-B radiation.
2. Response to UV-B also varies considerably among species and also cultivars of the same species. In agriculture, this will necessitate using more UV-B tolerant cultivars and breeding new ones.
3. In forests and grasslands, this is likely to result in changes in the composition of species; therefore, there are implications for the biodiversity in different ecosystems.
4. Indirect changes caused by UV-B such as changes in plant form, biomass allocation to parts of the plant, timing of developmental phases and second metabolism may be equally or sometimes more important that the damaging effects of UV-B.

Effects on aquatic ecosystems

1. Exposure to solar UV-B radiation has been shown to affect both orientation mechanisms and motility in phytoplankton, resulting in reduced survival rates for these organisms.
2. Solar UV-B radiation has been found to cause damage in the early developmental stages of fish, shrimp, crab, amphibians and other animals.
3. The most severe effects are decreased reproductive capacity and impaired larval development.

Effects on bio-geochemical cycles

1. Increases in solar UV radiation could affect terrestrial and aquatic biogeochemical cycles, thus, altering both sources and sinks of greenhouse and chemically important trace gases.
2. These potential changes would contribute to bio-sphere atmosphere feedbacks that reinforce the atmospheric build-up of these gases.

Effects on air quality

1. Reduction in stratospheric ozone and the concomitant increase in UV-B radiation penetrating to the lower atmosphere result in higher photo dissociation rates of key trace gases that control the chemical reactivity of the troposphere.
2. This can increase both production and destruction of ozone (O_3) and related oxidants such as hydrogen peroxide(H_2O_2), which are known to have adverse effects on human health, terrestrial plants, and outdoor materials.
3. Changes in the atmospheric concentrations of the hydroxyl radical (OH) may change the atmospheric lifetimes of climatically important gases such as methane (CH_4) and the CFC substitutes.)
4. Increased tropospheric reactivity could also lead to increased production of particulates such as cloud condensation nuclei, from the oxidation and subsequent nucleation of sulphur, of both anthropogenic and natural origin (e.g. carbonyl sulphide and dimethyl sulphide.

Effects on materials

1. Synthetic polymers, naturally occurring bio-polymers, as well as some other materials of commercial interest are adversely affected by solar UV radiation.
2. The application of these materials, particularly, plastics, in situations which demand routine exposure to sunlight is only possible through the use of light-stabilizers and / or surface treatment to protect them from sunlight.
3. Any increase in solar UV-B content due to partial ozone depletion will therefore accelerate the photo-gradation rates of these materials, limiting their life outdoors.

Question:

1. Discuss the Global environmental issues and its management briefly.