International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

Environment and Green House Effect

Dr. Gangadhar M. Sajjanar

Associate Professor in Zoology, S.V.M. Arts, Science & Commerce College, lkal-587125, Karnataka, India

Abstract: ***Panini the great scholar of Sanskrit named "Nature" as "Paryavaran" i.e. 'pari'+'Aavaran'= 'Paryavaran', a Yanadesh Sandhi. 'Pari' means surrounding and 'Aavaran' means place. Paryavaran means Environment i.e. surrounding. Science: Science is the systematic branch of knowledge where in people develops, organize and confirm facts or theories by observation, fasting and experimentation. In short, science is the systematic study of the physical world. Science develops a body of knowledge by organizing and verifying facts and theories through observation, tests and experiments. Technology or applied science applies that body of scientific knowledge to some practical use.***

1. Introduction

Environmental science is a multidisciplinary science involving Chemistry, Physics, Life Sciences, Agriculture, Medical Sciences, Public Health, Sanitary Engineering, Social Sciences etc

The objective of Environmental Studies/ Environmental Education is to enlighten about the importance of protection and conservation of our environment and the need t restrain human activities, which lead to indiscriminate release of pollutants into the environment.

Environment Segments: Comprise 4 segments

1. Lithosphere
2. Hydrosphere
3. Biosphere
4. Atmosphere

1) Lithosphere (Soil and Rock)

This is the outer mantle of solid earth consisting of minerals occurring in the earth's crust and the soil. The latter comprises a complex mixture of minerals (Inorganic Matter), organic matter air and water. The soil is the most important part of the most important part of the lithosphere.

2) Hydrosphere

The Hydrosphere includes all types of sources: Oceans, Rivers, Lakes, Streams, Reservoirs, Glaciers, Polar ice caps and ground water. About 97% of the Earth's water supply is in the Oceans, where the high salt content does not permit its use for human consumption. About 2% of the water sources is locked in the polar ice caps and glaciers, while only 1% is available as fresh water (surface water-rivers, lakes, streams, and ground water) for human consumption and other uses.

3) Biosphere

The kingdom of living organisms and their interactions with the environment (Viz: Atmosphere, Hydrosphere and Lithosphere). Both the Biosphere and Environment are influenced considerably by each other. Thus the 02 and CO2 levels of the atmosphere depend entirely on the plant kingdom. As a matter of fact green plants alone are responsible for the accumulation of O2 in the atmosphere, through photosynthesis and decay, the original atmosphere has been devoid of O2. The biological world, in general, is intimately related with energy flows in the environment and water chemistry.

4) Atmosphere

The atmosphere is the protective blanket of gases on the surface of the earth. It absorbs most of the cosmic rays from outer space and a major portion of the electromagnetic radiation from the sun. It transmits only part of ultra- violet, visible and near IR radiation {300-2500nm} and radio waves (0.14 -40m) while filtering out tissue damaged ultra violet light below about 300nm.

The atmosphere plays a key role in maintaining the heat balance of the earth through absorption of IR radiation emitted by the sun and remitted by the earth. The major components of the atmosphere are N2 and O2 while the minor components areCO2, argon and other gases in trace amounts.

The atmosphere is the source of O2 (essential for life on earth) and CO2 (essential for plant photosynthesis). It also supplies N2, which is an essential macro-nutrient for plants (via N2 fixation and fertilizer manufacture).

Furthermore, atmosphere is a carrier of water from oceans to land, which is so vital for the hydrological cycle.

Unfortunately, with progress in science and technology man has been dumping waste materials into the atmosphere, which are posing a problem for survival of mankind itself on earth.

2. The Natural Cycles of the Environment

The Hydrological Cycle

It is a continuous natural process which helps in exchange of water between the atmosphere, the land, the sea, living plants and animals. About one third of the solar flux (radiation) absorbed by the earth is used to drive the hydrological cycle-massive evaporation of water from the oceans, cloud formation and precipitation.

The Oxygen Cycle

O2 is a major component of all living organisms. O2 is needed by all living matter including human beings for aerobic respiration or enzymatic oxidation of food, which sustains growth and general metabolism. Thus is absorbed from the environment during aerobic respiration but released by plants during photosynthesis there by setting up the O2 cycle. There is also continuous exchange of O2 between the atmosphere and all water surfaces on the earth. The total

amount of O2 in the biosphere is relatively constant so that the O2 cycle is stable.

The Nitrogen Cycle
Nitrogen and its compounds are essential for maintenance of life processes in the biosphere. There is continuous exchange of N2 with in ecosystems operating the Nitrogen cycle. Plants and animals continuously produce proteins which are organic compounds containing N2. N2 converted into Nitrate/NH3 salts by micro-organisms.

The Phosphate Cycle
Phosphate are necessary for the growth and maintenance of animal bones and teeth which organophosphates are essential for cell division involving production of nuclear DNA and RNA. Plants and animals derive their nutrition via energy metabolic pathways utilizing ATP, adenosine triphosphate.

The Sulfur Cycle
Plants and animals depend on continuous supply of sulfur and its compounds for synthesis of some amino acids and proteins. Some sulfur bacteria serve as the media for exchange of sulfur with in ecosystems.

Pollutant
A substance present in nature, in greater than natural abundance due to human activity, which ultimately has a detrimental effect on the environment and there from on living organisms and mankind. (Ex:Pb,Hg,SO2,COetc,)

Contaminant
A material which does not occur in nature,but is introduced due human activity into the environment affecting its composition, A contaminant is classified as a pollutant when it exerts a detrimental effect. Ex: CL2

3. Masters of Mankind

10000 million B.C. : Universe was believed to be born
4600 million B.C. : Earth was born
1000 millions B.C. : Plants including Algae, fungi and bacterial evolved
500 million B,C. : Fish was evolved
200 million B,C. : Cockroaches were born
150 million B,C : Birds were born
60-20 million B,C. : Gigantic Reptiles rule the Earth
2 to 3 million B,C. : Man was born
50,000 B,C. : Man started thinking
10,000 B,C. : Man learned the art of cooking
2,850B,C. : Civilized life started in China

Solar Radiation
The energy from the Sun and the Stars is due to the conversion of matter into energy, mainly through the thermonuclear reaction.

$$4\,{}^{1}H \longrightarrow {}_{2}^{4}He + 2\beta^{+} + 2\nu$$

$$4\,{}^{1}H \longrightarrow {}_{2}^{4}He + 2\beta^{+} + 2\nu + \gamma$$

$$\Delta m = 0.0287U$$
$$= 26.7MeV$$

The mass loss resulting in the fusion of four protons into a helium nucleus, going on perpetually in the Sun and Stars is 0.02871U, Corresponding to 26.7 Me V per He nucleus formed.

Our Sun radiates around 3.8 x 10^{20} MJ of energy per second and this is indeed a very large amount of energy. In the process, the Sun suffers a mass loss at the rate of 4.2 x 10^{6} tones per second. This staggering mass loss of the Sun, however corresponds to just 10^{-5} percent per million years of its present mass (~2 x 10^{27}tones).There are however formidable difficulties to be overcome before this process can be reproduced on the earth and the energy harnessed for practical purpose.

The age of the Sun is about 5 x 10^{9} years and having about as much to go. Ninety percent of the Solar matter, is known to consist of Hydrogen and Helium, other elements mostly light constitute the rest of the matter(C,N,O)

The temperature at the center of the Sun is 1,50,00,000^{0}C,while the temperature at the surface of Sun is 6000^{0}C.

Green House Gases
Several of the gases naturally present in the Earth's atmosphere have the ability to absorb IR radiation (Solar radiation reflected by the Earth) and the heat generated will be reflected back to the surface of the Earth. This causes warming effect.
Natural Green-house effect is necessary for the optimization of temperature range for living things to exist on the earth. If there is no such blanket of IR absorbing gases, the night temperature would fall down much below the freezing point even in the warm tropics. But the hazardous aspect in the current green house effect is increase of such gases to a considerable extent in the atmosphere, which would increase the temperature causing global warming. A number of serious environmental problems are anticipated due to green house effect in near future.

Green House Effect/Global Warming Composition of the Atmosphere
The three categories of constituents present in atmospheric air –major, minor and trace expressed as percent by volume are as follows:
Major Components : Nitrogen (78.09)
Oxygen (20.94)
Water vapor (0.1-5)
Minor Components : Argon (9.34 x 10-1)
Carbon dioxide (3.25 x 10-2)
Trace Components : Neon (1.82 x 10-3)
Helium (5.24 x 10-4)
Methane (2 x 10-4)
Krypton (1.14 x 10-4)
Nitrous Oxide (2.5 x 10-5)
Hydrogen (5 x 10-5)
Xenon (8.7 x 10-8)
Sulphur Dioxide (2 x 10-8)
Ozone (trace)
Carbon dioxide (1.2 x 10-5)
Nitrogen dioxide (1 x 10-5)
Iodine (trace)

There are four major air pollutants emitted mainly by power stations and industry.

Nitrogen oxides, NOx emitted by power stations, industry and vehicles.

Sulfur Oxides Sox emitted by power station and industry. Carbon monoxide, CO emitted mainly by vehicle, soot and dust.

Suspended particulate matter (SPM) resulting from combustion of fuels.

Table 1: Concentration and increase of percentage of greenhouse gases

Greenhouse gas	Concentration ppm	Increase percentage per year
CO_2	356	0.4
CH_4	107	1.0
N_2O	0.3	0.3
CFC,s	0.0005	5

Green house effect is a normal phenomenon caused by the presence of water in the Earth's atmosphere, global warming is attributed to human activities. Other atmospheric gases such as CO_2, Chlorofluoro Carbons (CFC's), CH_4, Nitrogen Oxides (NO_x) and Ozone absorb IR radiation to a lesser extent than water. The global warming debate centers exclusively on these gases and totally ignores the effects of water. Of these gases, CO_2 is present to the greater extent in the atmosphere, its concentration is about 330 to 356 ppm (compared to 40,000 ppm for water) and it is claimed to be responsible for at least 50 to 60 percent of the potential heat buildup in the global warming theory. The CO_2 in the atmosphere comes from both natural and human controlled sources (from both breathing and carbon containing fuels).

The ability to absorb IR radiation by molecules depends on (1) the relative polarity difference between the atoms in a bond, (2) the presence of multiple bonds, (3) molecular shap and (4) the presence of unshared electrons (which has only a minor effect). The electro negativity (or polarity) differencesfor the green house gas atoms are 1.4 for H_2O, 1.5 to 0.5 (depending on the specific bonds) for CFCs 1.0 for CO_2, 0.5 for N_2O and 0.4 for CH_4.

In addition CO_2 has multiple bonds and water has a nonlinear structure that accentuates its polarity. Thus, both and absorbs IR effectively. The more the molecules absorbs IR radiation, the greater its molecular motion. This motion results in the temperature increase.

The total green house contribution of a particular type of molecule depends on (1) HOW much IR energy a molecule absorbs and (2) the concentration of the molecule in the atmosphere. At 40,000 H_2O ppm completely over shadows all other green house gases. Even if CO_2 absorbs as much IR energy as water, the warming effect of H_2O would be over a hundred times greater because its concentration is over a hundred times greater. Since H_2O actually absorbs IR energy than CO_2 the total warming from H_2O is even greater.

By the same reason if CO_2 and CFCs absorbs exactly the same amount of IR energy per molecule, the CO_2 would warm 3,30,000 times as much because the concentration differ to that extent. CFCs do absorb more IR than CO_2 but not nearly enough to over shadow the concentration factor. Methane absorbs a smaller amount of IR than the other gases listed and its concentration in the air is small. The net effect of all these factors is that H_2O is the most powerful greenhouse gas followed by CO_2, CFCs methane and N_2O.

Among the constituents of the atmosphere only CO_2 and water vapour strongly absorb infrared radiation (14000-25000 mm) and effectively block a large fraction of the earth's emitted radiation. The radiation absorbed by CO_2 and H_2O vapour is partly remitted to the earth's surface causing the earth's surface gets heated up by a phenomenon called the Green House Effect.

Deforestation along with increased fossil fuels have a cumulative effect on the net increase in CO_2 content.

The temperature effects of and CO_2 water vapour combine together to have a long range impact on the global climate. As the surface temperature increases with increase in level of CO_2 the evaporation of surface water increase, thereby raising the temperature further. This effect will bring about a 3^0 C rise in temperature for a doubling of the CO_2 concentration, which may occure around 2050 AD.

It may be noted that a slight increase in surface temperature say 1^0C may adversely affect the world food production. Thus the wheat growing zones in USSR and Canada will be shifted from the northern attitude to the poles i.e. from fertile to poor soils. Due to warming of ocean surface layer the biological productivity of the ocean would decrease and this reduces the transport of nutrients from deep layer to the surface by vertical circulation.

Another effect is the rise in sea levels. Since ocean act as reservoirs of heat, it could result in rise in sea levels by much as 2 meters due to expansion of sea water at increase temperatures, partial melting o glaciers, ice-gap of Greenland and also polar ice caps. This reise of sea levels would threaten coastal countries some 60 add island nation who face deep in roads by the sea, like the Maldives, Bangladesh may be totally submerged. In India Coastal Cities such as Madras, Goa may meet similar fates.

Rising temperatures also could alter the climate radically. More fertile lands could turn arid resulting lowering of production wheat and other food materials. More violet and floods are expected on the Eastern Coast.

Thus, CO_2, which constitutes 0.03 percent of atmospheric gases, plays an important role in changing the global climate. Without CO_2 the earth will be as cold as the moon. By trapping the heat radiation from the earth's surface, CO_2 regulates global temperature to life-sustaining 15^0C. But if the quantity increases too much, the earth surface may share the fate of its neighboring planet Venus with surface temperature of 450^0C.

Concentration and increase of radiatively active (green house) gases

Greenhouse gas	Concentration ppm	Increase percentage per year
CO_2	356	0.4
CH_4	107	1.0
N_2O	0.3	0.3
CFC,s	0.0005	5

Relative contributions of radiatively active gases to temperature rise.

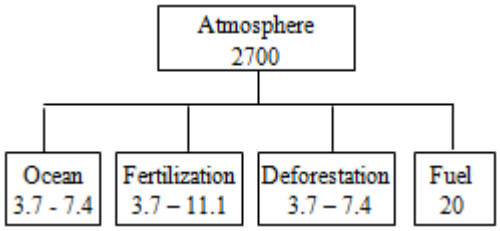
CH_4-sources, 360 million hectares of rice fields and 1.2 billion cattle emit CH_4.

Emission of Greenhouse gases (in million tons of Carbon):

USA-1000, CIS (formerly USSR) 690, Brazil- 610, China-380, India-230, Japn-220

Sources and Sinks of CO_2:

1) Emission by use of fossil fuels 20 x 109 (billion) tons of CO_2.
2) Emission by deforestation and changes in land use 5.5 x 109 tonnes CO_2.
3) Uptake in the Oceans 5.5 x 109 tonnes CO_2.
4) Uptake by CO_2 fertilization 7.3 x 109 tonnes CO_2.

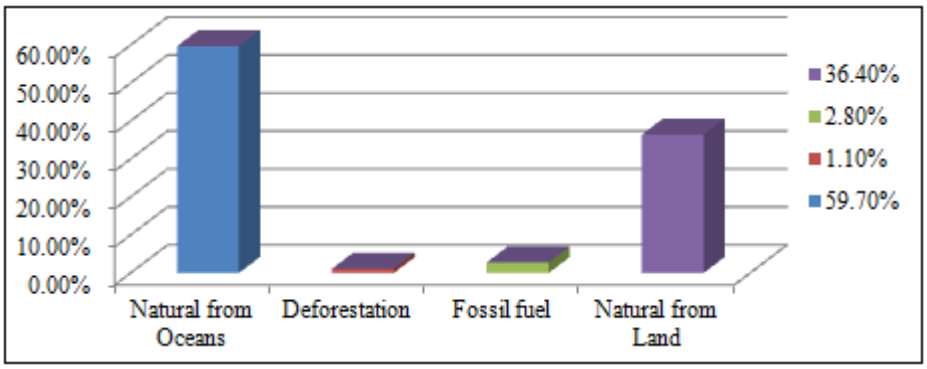


Overview of the most important fluxes of CO_2 (in billion tons i.e. 109 tonnes of CO_2)

The balance sheet shows a net increase of CO_2 in the atmosphere. This can be cut down to 50% if we can stop deforestation.

Table: Sources of in the atmosphere today.

Source	*Tonnes X 106*	*Percentage of Total*
NATURAL SOURCES		
Release from the Oceans	1,05,000	59.66
Release from the Land	64,000	36.36
Natural sources Subtotal	1,69,000	96.02
HUMAN – DERIVED		
Electric Power Plants	1,670	0.95
Transportation	1,590	0.90
Industrial/Commercial	1,375	0.78
Residential	365	0.21
Fossil Fuel Use Subtotal	5,000	2.84
Land Conversion (deforestation, etc)	2,000	1.14
Human – Derived Sources Subtotal	7,000	3.98
GRAND TOTAL	1,76,000	100.00



4. Preventive Measures

1) Restrict/reduce burning of fossil fuels – petroleum products – traffic pollution. Reduce generation of power from thermal stations:
   a) Utilize Solar radiation and
   b) H_2 as a fuel
2) Minimize deforestation, Increase of Vegetation and Increase of ground water level.
3) Burning of Agricultural waste/wood/plastic products
4) Utilize public transport/cycles and short distances prefer to go by walk.
5) Maintain clean and hygienic environment
6) Effective implementation of population control
7) Creating environmental awareness among students and public. (June 5th World Environment Day)

References

[1] "Enhanced Greenhouse Effect". Ace.mmu.ac.uk. Archived from the original on 2010-10-24. Retrieved 2010-10-15.
[2] "Synthesis Report: Summary for Policymakers" (PDF). IPCC Fifth Assessment Report. p. 4.
[3] Ascher, W. 1978 *Forecasting: An Appraisal for Policy-Makers and Planners*. Baltimore, Md.: Johns Hopkins.
[4] Binswanger, H. 1989 Brazilian Policies that Encourage Deforestation in the Amazon. Environment Department Working Paper No. 16. Washington, D.C.: World Bank.