

Global Warming and Its Impact on Environment

Shabir A.Wani¹, Malik Asif², Showket.A.Dar³, Shah Asif⁴

¹Temperate Sericulture Research Institute, Mirgund SKUAST-K (J&K) India; ² Division of Environmental sciences, SKUAST-K, Shalimar (J&K) India; ³ Division of Entomology, SKUAST-K, Shalimar (j&k) India; ⁴ Faculty of Forestry, SKUAST-K, Shalimar (J&K) India

*Corresponding author. Email:

Abstract Global warming is the observed and projected increase in the average temperature of earth's atmosphere and oceans. The earth's average global temperature has increased by 0.6°C in the last 140 years. Fine dust or aerosol particles floating high in the atmosphere can alter the heat balance of the earth by reflecting away the incoming solar heat, thereby making the surface cooler and by reflecting the escaping heat down towards the surface making it warmer. The balance of these two effects depends on the nature of the dust, season and time of the day for example a dust layer may tend to make the summer cooler and the winter warmer. The atmosphere is substantially influenced by the action of UV-radiation in ozone and water vapour. The main causes of global warming are greenhouse gases, power plants, population explosion, deforestation, transport sector and wet land destruction. Global warming has effects and consequences on all walks of life. The consequences of global warming can be seen in the atmospheric weather, local climate change, glacier retreat and disappearance, oceans, sea level rise, acidification, forest fires, ozone depletion, agriculture, water scarcity as well as the health of individuals. An increase of 2°C in temperature could decrease the rice yield by about 0.75 t/ha and 0.5°C increase in winter temperature reduce wheat yield 0.45 t/ha. Results have showed that about 7.4, 8.7 and 9.8 per cent of total cumulative CO₂, SO₂ and NO₂ emission respectively could be avoided between 1997 and 2015 by using efficient appliances.

Key words

Environment, Green House gases, Global warming and Pollution

The present day atmosphere has evolved from a mixture of gases released from the interior of the earth. The main gases released by volcanic activity are water vapor (64%, w/w) CO₂ (24%), SO₂ (10%) and nitrogen (1.5%). However, this mixture escaping from volcanoes over billions of years and acted upon by living organisms has produced an atmosphere which is mainly constituted by nitrogen and oxygen and a trace of CO₂ and other gases. In recent years environmental problem has developed to the global scale. The phenomena, such as ozone layer depletion, CO₂ increase, weather change, acid rain and oceanic pollution are treated as the problems of global cycle. On the other hand, fine dust or aerosol particles floating high in the atmosphere can alter the heat balance of the earth by reflecting the escaping heat down towards the surface making it warmer (Mackenzie, 1997). The balance of these two effects depends on the nature of the dust, season and time of the day, for example, a dust layer may tend to make the summer cooler and the winter warmer.

Greenhouse gases keep our planet warm. They exist naturally in the atmosphere, heating it by trapping energy that has originally come from the sun. This

process is called the natural greenhouse effect. Without the greenhouse gases the surface of the earth would be as cold as the surface of the moon, about -18°C. In fact the average surface temperature of the earth is about 15°C.

In the last 100 years the atmosphere has warmed up by over half a degree Celsius (°C). Also during this time humans have been releasing extra greenhouse gases which are the result of burning fossil fuels (like coal, oil and gas). Greenhouse gases are also released by the exhaust of motor vehicle and by the cutting down of forests.

If the earth continues to warm as predicted, the temperature of the earth's surface may be 3°C warmer by the end of the 21st century. This rapid change in temperature would have many impacts on environment and on society. Global warming will affect rainfall, sea level and the number and strength of extreme weather events such as storms and floods. Human health, agriculture and water supplies will all be affected.

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Global warming is projected to have significant impacts on conditions affecting agriculture,

including temperature, carbon dioxide, glacial run-off, precipitation and the interaction of these elements. These conditions determine the carrying capacity on the biosphere to produce enough food for the human population and domesticated animals. The overall effect of climate change on agriculture will depend on the balance of animals. The overall effect of climate change on agriculture will depend on balance of these effects. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt farming to maximize agricultural production.

As the same time, agriculture has been shown to produce significant effects on climate change, primarily through the production and release of greenhouse gases such as carbon dioxide, methane, and nitrous oxide, but also by altering the earth's land

cover, which can change its ability to absorb or reflect heat and light, thus contributing to radioactive forcing. Land use change such as deforestation and desertification, together with use of fossil fuels, are the major anthropogenic sources of carbon dioxide; agriculture itself is the major contributor to increasing methane and nitrous oxide concentrations in earth's atmosphere. Global warming is the observed and projected increase in the average temperature of earth's atmosphere and oceans. The earth's average temperature has risen by 0.6°C in the last 140 years. Global warming is an increase in global average surface temperature due to natural or anthropogenic climate change. It is clear from Fig. 1, that the global temperature shows the increasing trend in the temperature all over the world.

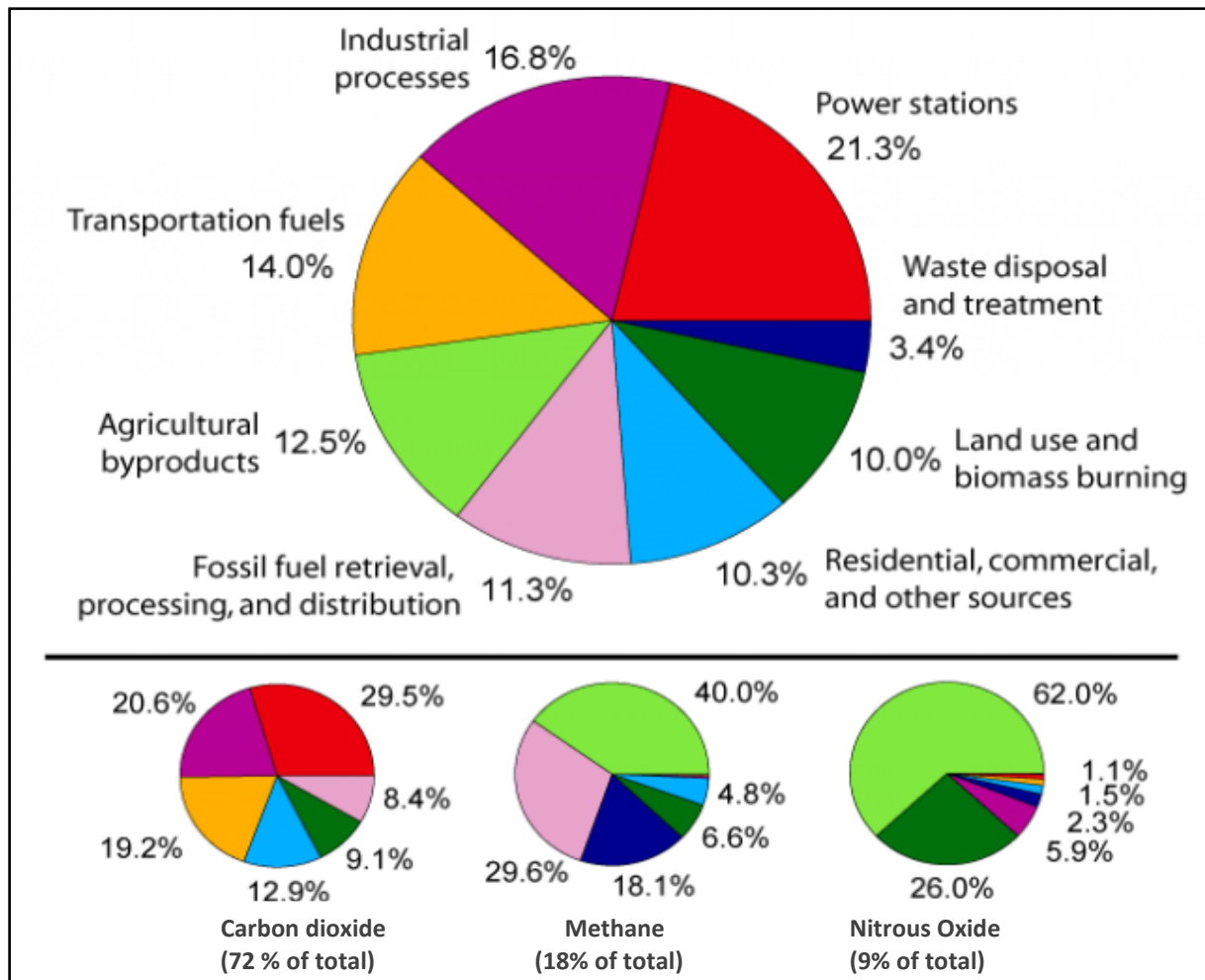


Fig. 1: Global warming: temperature increase in the last 140 years

Causes of Global Warming

Green House Gases

- Green house gases are the main causes of the global warming.
- Green house gases like carbon dioxide, methane and nitrous oxide are playing hazards in the present time.
- These green house gases trap heat in earth's atmosphere and thus results in increasing earth's temperature
- The excessive emission of these gases is the major cause of global warming.

[Source: www.globalwarming.org.in]

The fig. 2, reveals that the power stations are the major source of greenhouse gas emission which is followed by industrial processes, waste disposal and treatment are the least greenhouse emission sector. The increase of greenhouse gas concentration mainly carbon dioxide led to a substantial warming of the earth and the sea called global warming.

Power Plants

The major source of carbon dioxide is the power plants. Power plants emit large amounts of carbon dioxide produced from burning of fossil fuels for the purpose of electricity generation. Coal is the major fuel that is burnt in these power plants. Coal produces around 1.7 times as much carbon dioxide per unit of energy when flamed as does natural gas and 1.25 times as much as oil.

[Source : www.globalwarming.org.in]

Pollution

Thick haze and smoke, originating from burning biomass in northwestern India and air pollution from large industrial cities in northern India, often concentrate inside the Ganges basin. Dust and black carbon which are blown towards higher altitudes by winds at the southern faces of the Himalayas, can

absorb shortwave radiation and heat the air over the Tibetan plateau. The net atmospheric heating due to aerosol absorption causes the air to warm and convert upwards, increasing the concentration of moisture in the mid-troposphere and providing positive feedback that stimulates further heating of aerosols (Lau, 2006).

Population

There has been a recent interest in associating climate change/global warming with "over population" and countries such as China and India have to do more to help contain global warming. Yet rich countries have a lot to do themselves. The emission from rich countries that accumulated in the atmosphere for so long to trigger climate change (Mishra *et al.*, 2007).

Deforestation

Deforestation causes 25% of all carbon dioxide release entering the atmosphere, by the cutting and burning of about 34 million acres of trees each year. Cutting of trees is leading to greater concentration of carbon dioxide in the atmosphere.

Greater urbanization, requirement of land for factories and buildings, requirement of timber are also reasons that are leading to deforestation which in turn is leading to global warming.

(www.globalwarming.org.in)

Transport

Another major source of carbon dioxide in the atmosphere is the emission from cars and other vehicles. About 20% of carbon dioxide emitted in the atmosphere comes from burning of gasoline in the engine of the vehicles. It is always better to use vehicles designed for city driving on the city roads (www.globalwarming.org.in). Table 1 shows the major CO₂ Producing countries (Guardian, 2007).

Table 1

Major CO₂ emitting countries

Country	CO ₂ Emissions (in billion tones)
USA	5.9
CHINA	4.7
RUSSIA	1.7
JAPAN	1.3
INDIA	1.1

Effects of Global warming

Effect on the economy

The Indira Gandhi Institute of Development Research has reported that climate-related factors could cause India's Gross Domestic Products (GDP) to decline by up to 9%. Around seven million people are projected to be displaced due to, among other factors, submersion of parts of Mumbai and Chennai, if global temperatures were to rise by a mere 2°C (Smith *et al.*, 2007). Villagers in India's North Eastern State of Meghalaya are also concerned that rising sea level will submerge neighboring low-lying Bangladesh resulting in an influx of refugees into Meghalaya. If server climate changes occur, Bangladesh will lose land along the coast line (Ahmad *et al.*, 2006).

Effect on environment

Since the beginning of the industrial revolution in the second half of the 18th century, the levels of pollutant increased in the atmosphere by as much as 33 per cent. Flooding, coastal erosion, droughts, salt water intrusion into soils, unusual high levels of tropical storm, cyclones, huge loads of rain are among the effects seen in various parts of the world during the past years which have been attributed to global temperature rise. The rising sea levels cause flooding in many parts of the world. Over the past 100 years, the sea level has risen by almost 1 meter as a result of warming of our planet (Anup *et al.*, 2006).

Extreme weather

Global warming may be responsible on past for some trends in natural disasters such as extreme weather. There will be increased intense tropical cyclone activity. There will be increased incidences of extreme high sea level (Stefan *et al.*, 2007).

Local Climate Change

The first recorded south Atlantic hurricane "Catarina" which hits Brazil in March, 2004. In the northern hemisphere, the southern part of the Arctic region has experienced a temperature rise of 1 to 3°C over the last 50 years. Canada Alaska and Russia are experiencing initial melting of permafrost. This may disrupt ecosystems and by increasing bacterial activity in the soil lead to these areas becoming carbon sources instead of carbon sinks (Vladimir and Romanov sky, 2007).

Glacier retreat and disappearance

Excluding the ice caps and ice sheets of the Arctic and Antarctic, the total surface area of glaciers worldwide has decreased 50% since the end of the 19th century. Currently glacier retreat rates and mass balance losses

have been increasing in the Andes, Alps, Pyrenels, Himalayas, Rocky mountains and North Cascades. The loss of glaciers not only directly cause landslides, flash floods and glacial lake overflow but also increases annual variation in water flows in rivers (Mauri and Pelto, 2007).

Oceans

The oceans serve as a sink for carbon dioxide, taking up much that would otherwise remain in the atmosphere but increase levels of CO₂ have led to ocean acidification. As the temperature of oceans increases, they become less able to absorb excess CO₂. Global warming is projected to have a number of effects which include rising sea level due to thermal expansion and melting of glaciers and ice sheets (Christian *et al.* 2003).

Sea level rise

With increasing average global temperature, the water in the oceans expands in volume and additional water enters than which has previously been locked up on land in glaciers, e.g. Greenland and Antarctic ice sheets. For most glaciers worldwide, an average volume loss of 60% until 2050 is predicted. The total ice melting rate over Greenland is 2.39±23 cubic km per year. The United States, parts of Canada and the Indian Ocean would experience up to 6.5 meters of sea level rise (Christian *et al.* 2003).

Temperature rise

From 1961 to 2003, the global ocean temperature has risen by 0.10°C from the surface to a depth of 700 m. The temperature of the Antarctic southern ocean rose by 0.17°C (0.31°F) between the 1950s and the 1980s nearly twice the rate for the world's oceans as a whole. Having effects on ecosystems by melting sea ice, warming reduces the ocean's ability to absorb CO₂ (Bindoff *et al.* 2007).

Acidification

Ocean acidification is an effect of rising concentration of CO₂ in the atmosphere. Oceans currently absorb about one tonnes of CO₂ per person per year. It is estimated that the oceans have absorbed around half of all CO₂ generated by human activities (Sabine *et al.* 2004).

Methane release from hydrates

Methane clathrate also called methane hydrate is a form of water ice that contains a large amount of methane within its crystal structure. The sudden release of large amounts of natural gas from methane clathrate deposits in a runaway greenhouse effect has been

hypothesized as a cause of past and possibly further climate changes. The release of this trapped methane is a potential major outcome of a rise in temperature (Connor, 2008).

Forest Fires

The Inter-Governmental Panel on Climate Change (IPCC) Fourth Assessment Report predicts that many mid-latitude regions such as Mediterranean Europe will experience decreased rainfall and an increased risk of drought, which in turn would allow forest fires to occur in large scale. This releases more stored carbon into the atmosphere than the carbon cycle can naturally re-absorb, as well as reducing the overall forest area on the planet, creating a positive feedback loop. Part of the feedback loop is more rapid growth of replacement forests and a northward migration of forests as northern latitude became more suitable climates for sustaining forests (USEPA, 2007).

Effect on sulfur aerosols

Sulfur aerosols, especially stratospheric sulfur aerosols have a significant effect on climate. One source of such aerosols is the sulfur cycle where plankton releases gases which eventually become oxidized to sulfur dioxide in the atmosphere. Disruption to the oceans as a result of ocean acidification or disruptions to the thermohaline circulation may result in disruption of the sulfur cycle, thus reducing its cooling effect on the planet through the creation of stratospheric sulfur aerosols (Lawrence *et al.* 2008).

Ozone Depletion

There are two types of stratospheric ozone depletion, the conventional type and the ozone hole type. It has been reported that the depletion of ozone is due to technology progress in rocketing, supersonic aircraft flight, refrigeration, nitrogenous fertilizers and others. An abundance of ozone near the earth's surface has resulted in damaging effects on human health, agriculture crops, ornamental plants, forests and materials. It has become clear that a decrease in emissions of nitrogen oxides may be needed in areas where ozone concentrations are high (Thukral and Virk, 2000).

Effect on Agriculture

Sinha and Swaminathan (1991) observed that an increase of 2⁰C in temperature could decrease the rice yield by about 0.75 tons/ha in the high yield areas and 0.5⁰C increase in winter temperature would reduce wheat yield by 0.45 tons/ha. Rao and Shina (1994) reported that wheat yield could decrease between 28-68% without considering the carbon dioxide

fertilization effects. Saseendran *et al.* (2000) reported that for every one degree rise in temperature the decline in rice yield would be about 6%.

Solutions to Global Warming

When you buy your car, look for the one with the best fuel economy in its class. Each gallon of gas you use is responsible for 25 pounds of heat-trapping gases in the atmosphere. Better gas mileage not only reduces global warming, but will also save your thousands of dollars at the pump over the life of the vehicle.

Choose clean power

More than half the electricity in the United States comes from polluting coal-fired power plants. Power plants are the single largest source of heat trapping gas. None of us can live without electricity, but in some states, you can switch to electricity companies that provide 50-100 per cent renewable energy (Ponce, 2009).

Look for energy star

When it comes time to replace appliances, look for the energy star label on new appliances (refrigerators, freezers, furnaces, air conditioners and water heaters use the most energy. Household energy savings really can make a difference. If each household in the United States replaced its existing appliances with the most efficient models available, we would save 15 billion dollars in energy costs and eliminate 175 million tonnes of heat-trapping gases (Ponce, 2009).

Unplug a freezer

One of the quickest ways to reduce your global warming impact is to unplug the extra refrigerator or freezer you rarely use. This can reduce the typical family's carbon dioxide emissions by nearly 10 per cent (Ponce, 2009).

Plant a tree

Get a group in your neighborhood together and contact your local arborist or urban forester about planting trees on private property and public land. In addition to storing carbon, trees planted in and around urban areas and residences can reduce energy bills and fossil fuel use (Ponce, 2009).

Let Policy Makers know you are concerned about global warming

Our elected officials and business leaders need to hear from concerned citizens. Sign up for the union of concerned scientists action network to ensure that policy makers get the timely accurate information they

need to make informed decisions about global warming solutions (Ponce, 2009).

Global warming control strategies on international level

The World Meteorological Organization (WMO) has the responsibility to coordinate the environmental issues related to the atmosphere including air quality, on a global basis. About 7.4, 8.7 and 9.8 per cent of total cumulative CO₂, SO₂ and NO₂ emission respectively could be avoided between 1997 and 2075 by using efficient appliances (Shrestha *et al.* 1998). Dioxin emissions can be reduced by flue gas treatment by bag filter and flyash treatment by sintering (fusion solidification), chlorination, thermaldehyde and other photolytic and chemical methods (Ahuja, 2008).

Copenhagen Conference

The intention of conference of parties (cop) in Copenhagen was to complete negotiations on a new international agreement on climate change to come into force before 2012. The three page Copenhagen accord managed to secure the unanimous approval of the conference of parties (cop). Point-1 of the Accord, the parties “recognize” the scientific view that the increase in global temperature should be below 2 degree Celsius. Point-2 “deep cuts in global emission are required according to science and as documented by the IPCC Fourth Assessment Report with a view to reduce global emissions so as to hold the increase in global temperature below 2°C, and to take action to meet this objective consistent with the science and on the basis of equality. The final accord was hammered out by the US, China, India, Brazil and South Africa and presented as “take it or leave it” to the rest of the parties, including the EU.

Conclusion and Future Strategies

It is imperative that the developed countries and the rapidly developing countries formulate strategies to curb green house gas emissions. Countries on the fast track of economic growth should also look at adopting new energy saving technologies. It is imperative to carry out a massive reforestation. The emphasis also is laid on increasing the use of renewable energy sources like solar and wind. Application of fertilizer should be reduced.

Literature cited

1.Ahmad, A., Koudstall, R. and Werners, S, 2006. ‘Key Risks’. Considering Adaptation to climate change towards a sustainable development.

- 2.Ahuja, I. 2008. Global climate change. *Ecol. Modell.* **87**: 51-57.
- 3.Anup, K., Prasad, V.K. and Pant, G.B. 2006. Long-term climate variability and change over monsoon. *Journal of the Indian Geophysical Union* **7**(3): 125-134.
- 4.Bindoff, N.L., Willebrand, J., Artale, V. 2007. Oceanic change and sea level. *The Physical Science* **2** : 105-107.
- 5.Cannor, S. 2008. Hundreds of methane plumes discovered. *The Independent*.
- 6.Christan, P., Wilson, E. and Schneeberger, K. 2003. Modelling changes in the mass balance of glaciers of the northern hemisphere. *Journal of Hydrology* **282** : 145-163.
- 7.Global Warming: Impacts on Forests. United States Environmental Protection Agency, 2007. In: [www.globalwarming.org.in]
- 8.Lawrence, D.M., Slater, A.G. and Tomas, R.A. 2008. Accelerated arctic land warming and permafrost degradation during rapid sea ice loss. *Geophysical Research Letter* **35** : 1506.
- 9.Mackenzie, D. 1997. Impact of Pollutants on Environment. *Forest Fab.* **156** : 15.
- 10.Mauri, S. and Pelto, K. 2007. Recent retreat of north-cascade glaciers and changes in north cascade stream flow. *North Cascade Glacier Climate Project*.
- 11.Mishra, S., Ramesh, R., Amit, R., Lazar, B., Rajaguru, S.N. and Sandler, A. 2007. High-resolution holocene environmental changes, Northwestern India. *Science* **284**(5411) : 125.
- 12.Ponce, V. Migue 2009. The thirty three facts about global warming. *Nature* **510** : 140-148.
- 13.Rao, A. and Sinha, A.K. 1994. Climate changes and agriculture. *Nature* **437** : 102-109.
- 14.Sabine, T., Sarah, G. and Christopher, L. 2004. The ocean sink for anthropogenic CO₂. *Science* **385**(5682) : 367-371.
- 15.Saseendran, R.M., Smith, I.M. and Matson, P.A. 2000. Ecological and evolutionary responses to climate change. *Science* **284**: 1943-1947.
- 16.Shrestha, R.M., Natarajan, B., Chakravarti, K.K. and Shrestha, R. 1998. *Energy Oxford* **23** : 1065-1072.
- 17.Sinha, A.K. and Swaminathan, M.S. 1991. Long-term climate variability and changes. *Journal of Indian Geographical Union* **7**(3): 125-134.
- 18.Smith, J., Hitz, S., Akhter, R. 2002. Climate change and Human Health-Risk and Responses. WHO Geneva.
- 19.Stefan, R., Michal, M. and Rasmus, B. 2007. Hurricanes and global warming. *Science* **2** : 95-98.
- 20.Thukral, A.K. and Virk, G.S. 2001. Environment Protection. *Indian Journal of Environmental Prot.* **13** : 358-367.
- 21.Vladimir and Romanovsky, 2007. Climate changes and retreat of glaciers. *Nature* **377** : 687-688.