

# Global Warming

---

The atmosphere maintains life-sustaining conditions on Earth. Each day, the land, seas, mountains, etc., absorb energy from the sun. If all this energy were to be absorbed completely, would the earth gradually become hotter and hotter? Actually, the earth both absorbs and, simultaneously, releases energy in the form of infrared waves. All of this rising heat is not lost to space, but is partly absorbed by some gases present in minute quantities in the atmosphere, called GHGs (Greenhouse gases). Greenhouse gases (for example, carbon dioxide, methane, nitrous oxide, water vapour and ozone) re-emit some of this heat to the earth's surface. An increase in the levels of GHGs could lead to greater warming, which, in turn, can impact the world's climate, leading to the phenomenon known as climate change.

## What is Climate Change?

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period. Climate change may be a result of either natural internal processes or external forcings, or even persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate is the average weather over an extended period of time. The components of the global climate, atmosphere, hydrosphere, cryosphere, biosphere, and the geosphere interplay with one another in order to create and maintain the climate. Any alteration in any of these components will have a corresponding impact on the climate. The scientific community generally agrees that the globe has warmed over the past 40 years, largely due to anthropogenic causes. Energy use, transit and land management have sharply increased the atmospheric concentration of common greenhouse gases like carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and chlorofluorocarbons (CFCs), increasing average global temperatures (Article & Web Alert, 2007).

The International Panel on Climate Change (IPCC), an international body, projects that the global mean temperature may increase between 1.8° C to 4° C by 2100. This unprecedented increase is expected to have a severe impact on the global hydrological system, ecosystems, sea level, crop production and related processes. The impact would be particularly severe in the tropics, which mainly consist of developing countries, including India (Survey of the Environment, 2007).

## Melting of the Gangotri Glacier

The river Ganges originates in the Himalayas, fed by several glaciers. The Gangotri is the longest of these glaciers, an impressive 26 km in length. Scientists studying this glacier have found it retreating at a rate of 20 metres a year, as compared to about 16 metres per year in the past. If the present trend continues, then over the next 25 years, the Ganges can initially swell in volume because of increased melting but then dry out, as the water supply in the mountains will run low. This will endanger the lives of about 400 million people who live in the river's plains and whose very lives depend on it (Survey of the Environment, 2007).

## Impact on Forest Ecosystems

Climate change has the potential to adversely impact natural ecosystems such as forests and socio-economic systems such as food production and fishing. A scientific study reveals that the projected climate change is likely to lead to increased water scarcity, increased drought, high rainfall threat to the biodiversity, shift in forest types, altered species composition, reduction in food production in dry tropics with increased risk of hunger and flooding due to the rise in the sea level. Climate is probably the most important determinant of vegetation patterns and has significant influence on forest distribution, species dominance, and plant productivity and, in general, the ecology of forests. In recent decades, global warming has already made an impact on forest ecosystems such as a poleward and upward shift in ranges of plant, insect, bird and fish species. Further, plant flowering, bird arrival and dates of breeding and flowering are observed to be occurring earlier than before in the seasons. An assessment of the Impact of climate change shows the possibility of large-scale mortality of tree species under the changed climatic conditions. Thus, any impact on forest vegetation and biodiversity will have adverse implications for the livelihoods of forest-dependent communities (Survey of the Environment, 2007).

## Impact on Biodiversity

Ecosystems have a limited capacity to adapt to climate change. Through different years, the inhabitants of this planet have adapted and evolved with the changing climatic conditions of their surroundings. When the rate and extent of climate change exceeds nature's maximum adaptation speed, it may lead to the extinction of several species. The inability to adapt to rapid environmental changes has drastic implications. It is estimated that by 2100, two-thirds of the Earth's remaining species might become extinct (Article & Web Alert, 2007).

Independent of climate change, biodiversity in India is under threat and is projected to decline in the future due to multiple pressures such as increased land-use intensity, forestland conversion, non-sustainable extraction of biomass, overgrazing and forest fires. The projected climate change is likely to adversely impact the biodiversity since the future climate will not be optimally suited to the current forest type and species mix. The species extinction, already occurring in India, may further accelerate. Many existing species may be subjected to dying of plants due to warming, mortality and poor regeneration. For example, the endemic Nilgiri Tahr may be threatened if the montane grasslands of the Western Ghats are invaded by woody plants. Similarly, upward altitudinal migration of plants in the Himalayas can reduce the alpine meadows and related vegetation, adversely impacting the habitats of several high-altitude mammals including wild sheep, goat, antelope and cattle (Survey of the Environment, 2007).

## Impact on Agriculture

Global warming is predicted to affect agricultural production. In the tropics and sub tropics, with prevailing high temperatures, crops

are already growing at a particular threshold where dry land, non-irrigated agriculture dominates. Therefore, even with slight changes in temperature, yields are likely to decrease noticeably.

Agricultural productivity is sensitive to two broad classes of climate-induced effects: direct effects from changes in temperature, precipitation, radiation, or carbon dioxide concentrations, and indirect effects through changes in soils and the distribution and frequency of infestation by pests and diseases. However, much depends not only on the physiological response of the affected plant, but also on the ability of the affected socio-economic systems of production to cope with changes in yield and in the frequency of droughts or floods. The Third Assessment Report (TAR) of the IPCC indicates that India's rice and wheat production will drop significantly because of climate change (Survey of the Environment, 2007). For example, in Kullu Valley in the state of Himachal Pradesh, the apple belt has moved 30 kilometers (northwards) over the last 50 years. Earlier, Bajaura (a low point of the valley) was once the starting point for apple, but now there is no apple below Raisan, a midpoint of the valley. It has been noted that with the change in climate, respondents most often began their response by describing the changed pattern of snowfall.

### **Impact on Coastal Environment**

The IPCC (2007) and the Stern Review Committee predicted that the coastal belts are more prone to the devastating impacts of global warming. Assessments show that one metre sea level rise can lead to welfare loss of \$1,259 million in India, equivalent to 0.036% of GNP. India's coastline is about 7500 km long and is densely populated as well as low lying. Tropical cyclones and storm surges are one of the most critical factors affecting loss of human lives in India. There is concern that global warming may affect tropical cyclone characteristics - including intensity - because sea-surface temperature (SST) plays an important role in determining both the weather and tropical disturbances.

Most of India's coastal regions are fertile and under paddy cultivation, which is sensitive to inundation and salinisation. Coastal infrastructure, tourist activities and onshore oil exploration are also at risk. Variations in climatic patterns are expected to result in an increase in the frequency and intensity of extreme events such as cyclones. These will greatly affect the population in coastal areas and may cause devastation in low-income rural areas, as exemplified by the cyclone that hit Orissa in 1999, killing about 10,000 people. A one-metre rise in the sea level is expected to inundate about 1700 km<sup>2</sup> of agricultural land in Orissa and West Bengal (IPCC, 1992). The coastline of Orissa is frequently affected by severe climate change initiated cyclones, as also other natural calamities like drought and flood. The sea has encroached to about 1.5 km into Satavaya and 2.5 km into Kanakpur. Satavaya has also lost 56% of its mangrove vegetation. In Tamil Nadu, the most vulnerable coastal districts are Nagapattinam, Cuddalore and Kanyakumari.

### **Coral Bleaching in the Gulf of Mannar Biosphere Reserve**

Corals are losing their attractive colours. These stunningly coloured 'rainforests of the ocean' are some of the oldest and most biologically diverse ecosystems on earth. Corals are very sensitive to changes in the temperature of the water in which they live; an increase of even a couple of degrees centigrade can spell danger to their survival. The coral get bleached after Zooxanthellae, an

algae that lives in corals and is responsible for its beautiful colours, is either killed or reduced, as a result of an increase in the temperature.

Bleaching over prolonged periods not only causes the spectacular colours to fade, but also weakens the corals, making them more vulnerable to diseases. Over the past two decades, there has been a rapid increase in the number of bleaching events (MoEF, 2007). In Gulf of Mannar, Tamil Nadu, it was reported that coral bleaching has increased from 14.9% to 15.5% from 2005 to 2006.

### **Global Initiatives**

IPCC was established in 1988 with an objective of evaluating the scientific evidence on global warming, assessing the environmental and agricultural impacts of climatic change, and formulating responses. In 1992, representatives from 178 nations, Non Government Organisations (NGOs) and other interested parties met in Rio de Janeiro, Brazil, to discuss global environmental issues. The first United Nations Conference on Environment and Development (UNCED) is widely regarded as the most important international environmental conference to date and is popularly known as the Earth Summit. This Summit resulted in treaties on biodiversity and climate change, and the assembled countries adopted 'Agenda 21', a blueprint to promote sustainable development. The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992, which came into force in 1994 with the ultimate objective of stabilising greenhouse gas concentrations in the atmosphere. The convention also led to the establishment of a Conference of the Parties (COP), which functions as the supreme implementing body of the Convention. In 1997, the third COP session held in Kyoto, Japan, resulted in the adoption of the Kyoto Protocol to the UNFCCC. The Protocol calls for legally binding commitments to reduce greenhouse gas emissions by 5.2% below 1990 levels by the period 2008-2012. The Kyoto Protocol came into force on February 16, 2005 following ratification by Russia in 2004 (Article and Web Alert, 2007).

### **Government Initiatives**

India has undertaken numerous response measures that are contributing to the objectives of the United Nations Framework Convention on Climate Change (UNFCCC). India's development plans balance economic development and environmental concerns. The planning process is guided by the principles of sustainable development. Reforms in the energy and power sector have accelerated economic growth and enhanced the efficiency of energy use. These have been complemented by notable initiatives taken by the private sector. In the last few years, several measures relating to environmental issues have been introduced. They have significantly targeted the capacity of renewable energy installations; improving the air quality in major cities (the world's largest fleet of vehicles fuelled by compressed natural gas has been introduced in New Delhi); and enhancing afforestation. Other similar measures have been implemented by committing additional resources and realigning new investments, thus placing economic development on a climate-friendly path (MoEF).

*(Source: ENVIS Newsletter vol. 4, No. 2, 2007, Department of Environment, Govt. of Tamil Nadu, Chennai)* □