

CLIMATE CHANGE AND DIFFERENTIAL IMPACT ACROSS THE WORLD

R S Deshpande and Neha Chaturvedi*

First it was the Drought and now the Rains.....everybody observes these changing weather patterns. Gone are those days when people expected a rainy season in particular months of the year. The trend is changing, there have been shifting weather patterns over the years, which is being termed as Climate Change. The delay in the monsoon arrival, or prolonged drought in the southern part of the country, make these changes in the climate quite obvious.

The climate change is a scientifically explained phenomenon taking place over the years and affecting different regions differently, depending on their geographical location, distance from the sea or ocean, land use and the economic state. The climate change was considered to be a naturally occurring phenomenon until recently when it was suggested that human emissions could be a party to the changing trends. Like every coin has two sides, the issue of 'Human Induced Climate Change' also has two versions. One school of thought suggests that the change is but natural and the human contribution to it is negligible. On the other hand, the second opinion states that the changes in the climate are a result of the human emissions over the years, especially since the industrial revolution.

The issue of climate change came into the limelight with the proposal of the Kyoto Protocol. The studies conducted by the International Panel on Climate Change (IPCC), suggested that climate change was infact taking place but at a very slow rate. This trend could however be intensified by the anthropogenic emissions. Thus, in order to check the change, the United Nations Framework Convention on Climate Change (UNFCCC) was formed which after intensive studies and deliberations proposed the Kyoto Protocol. The aim of the protocol is to reduce the emissions to pre-industrial levels

* Professor and Head, ADRT Unit Institute for Social and Economic Change, Nagarbhavi, Bangalore, 560 072. This is based on the Masters' thesis of the Junior author completed under the guidance of the Senior author. Contact address deshpande@isec.ac.in

in order to decelerate the warming of the world. This however has not been possible as the various countries of the world have not come to the consensus that enhanced climate change is actually taking place and that a step needs to be taken towards reducing the emissions.

The climate change can be explained on the basis of the interactions between the solar radiation reaching the earth and the components of the earth system. The amount of energy that is trapped determines the weather of an area on a day-to-day basis and the climate over a longer period of time. The human emissions just add to the whole process of climate variability. As the semantics go, the climatic change emerges from the composite of the world climate

The impacts of climate change are inevitable. The impacts will be felt at varying degrees in different regions depending on their geographical location, present climatic condition, economic condition, population of the region etc. Especially the vulnerable will be affected more severely than those countries, which have the capacity to survive the shocks. Considering these factors, the impact will be felt more in the developing and economically backward countries. The developed countries will also face the brunt of climate change but due to their economic stability, they will be able to cope with the situation. This chapter incorporates a discussion on the differential impact or climatic change perceived under various studies. Here we look at the impact from two angles, namely, those countries that have contributed to the change in GHGs and the likely impact on the other countries. That makes it clear that probably contributors to the problem do not suffer as much as those who have little share in the imbalance of GHGs.

The study of the past climates, over a million years, indicates that there have been glacial periods interspersed with the inter-glacial (warming) periods. The climate keeps fluctuating between the warm and the cold, and this has been occurring naturally. Depending on the temperature, the sea-level also varies. The fact however remains that the world today is facing a warming trend, which may be occurring as part of the natural climatic cycle but it is surely enhanced, if not caused, by the human greenhouse gas

emissions. The warming trend has been quite evident in the past few years with 1998 being the warmest year. This warming trend is likely to continue for the years ahead also.

Annual carbon budget

The carbon budget is maintained by the carbon cycle, which takes place naturally, as discussed in Chapter I. In addition to this, the emission from the countries determines the carbon budget. The observed carbon budget for the developing and developed countries is shown in the Fig.1. The figure shows that the share of developing countries in the mean global CO₂ emission increased from 1980 to 1990, the increase in the magnitude was reported to be of the order of 3.3 to 4.1 GtC. The increase in emission due to tropical deforestation is 39% from the non-Annex I countries (developing countries).

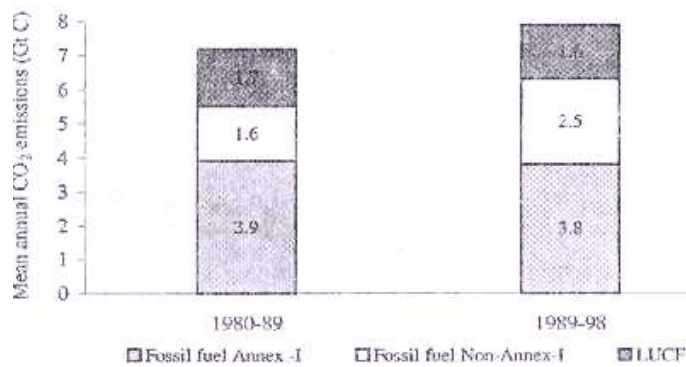
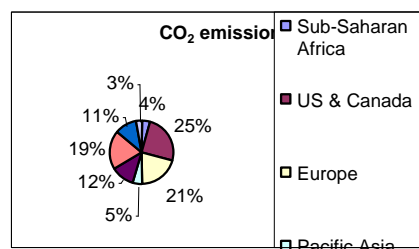


Figure 1: Mean Annual CO₂ emissions



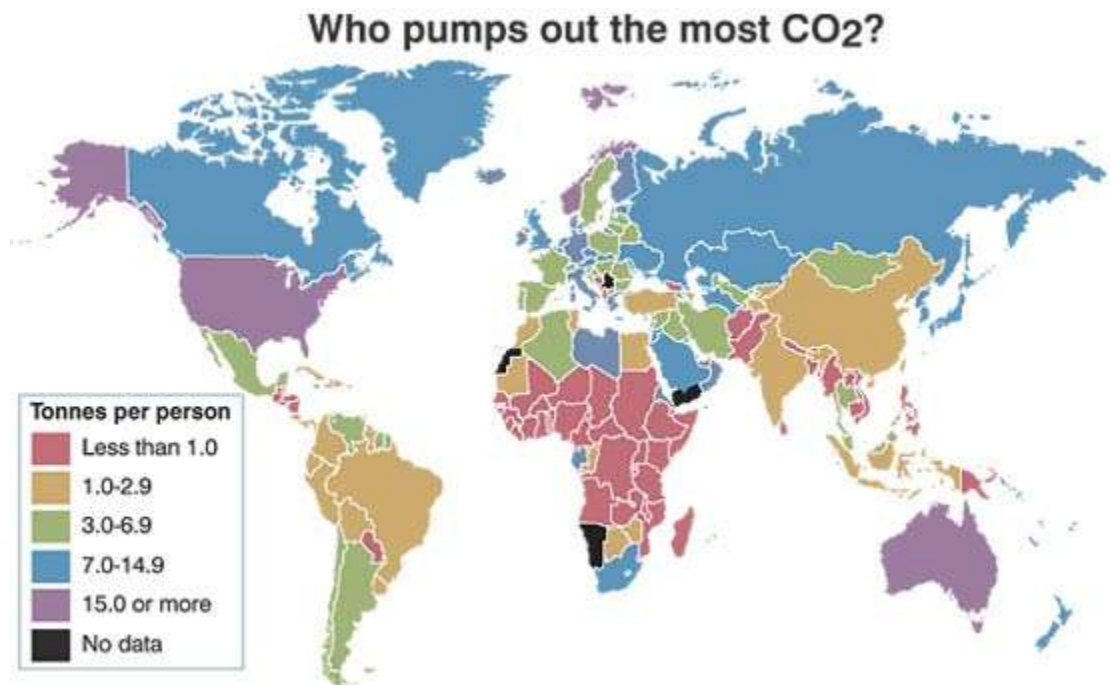
Source: Ravindranath, NH and Sathaye

Figure 2 :Cumulative global CO₂ Emissions from Industrial and Land-use Change during 1900-99

The figure indicates that USA and Canada together contribute quarter of the cumulative CO₂ emissions. The industrial nations consisting of North America, Europe, industrial Asia and former Soviet Union together contribute 63% of the emissions. On the other hand, developing countries contribute only about 37% from fossil fuel burning and land use change.

World's Contribution:

Figure 3: World's contribution to the Emissions



Source: www.newscientist.com

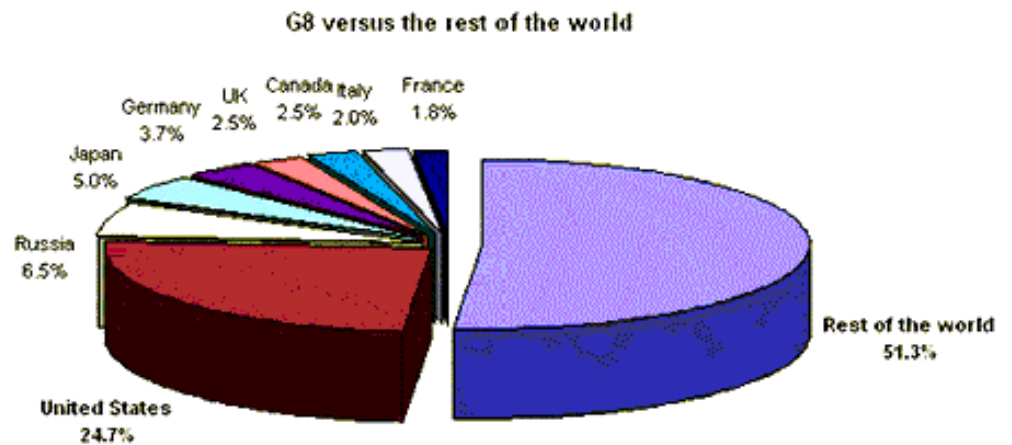
The major contributors to the CO₂ emissions are the developed countries. These countries also have a higher per capita emission due to better standards of living. According to studies by CSE, the GHG emission of one US citizen is equal to that by 19 Indians. The Fig. 4.2.1 clearly indicates that high emissions per person are seen in Canada and the European Countries. However, highest emission (15 tons/person) is seen

in Alaska, US and Australia. The emissions for the developing countries are shown as low as 1-2.9 ton/person.

Country Specific Emissions

The country specific emissions and their comparison with the total world emission helps to determine the contribution of each country and thus the reduction required to be made by them in order to curb climate change based on the Kyoto Protocol rules. The statistics indicate that the major contributors are the developed countries. The G8 countries are the major polluters of the environment and emitted around 48.7% of world CO₂ in 1999. They are- Canada, France, Germany, Italy, Japan, UK, US and Russia. The contribution due to fossil fuel burning and flaring can be seen in the chart below:

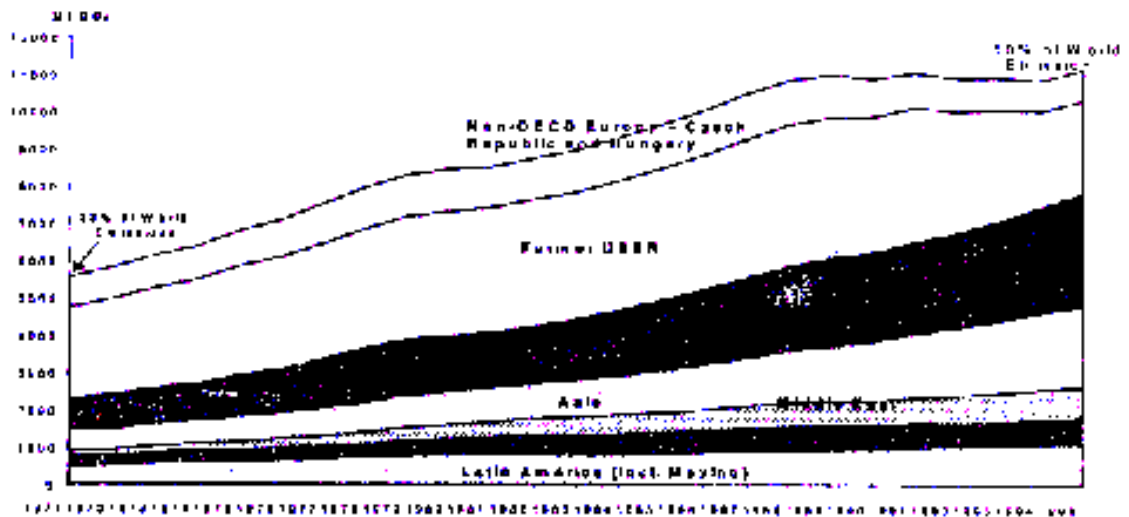
Figure 4.: Source of CO₂ emission from consumption and flaring of fossil fuel, 1999



Source: www.panda.org

The world emissions from fossil fuel burning increased from 14.73 GtC in 1971 to 22.98 GtC in 1997. The developing countries and countries in transition accounted for 5.56 Gt CO₂ in 1971, which was 38% of the world emissions. The 1995 emissions showed a doubling of this figure to 11.16 Gt CO₂, increasing its contribution to 50%. The world projection for 2020 is between 25.7 and 44.4 Gt CO₂, and a growth rate of 2% annually will be observed between 1996 and 2020 (Ravindranath & Sathaye, 1998)

Figure 5: Carbon Emissions from non-OECD countries



Source: Ravindranath, NH and Sathaye, 1998

Table 1 : Country specific carbon emissions

Countries	1971	1995
Africa	11%	20%
Asia	83%	88%
Latin America	52%	64%
World	10%	25%

Source: NH Ravindranath, 1998

The impact of emission from a country is calculated based on the population, economic growth, energy intensity and carbon intensity. This is also termed as the IPAT identity, which was formulated by Ehrlich and Holdern (1974):

$$\text{Impact} = \text{Population} * \text{Affluence} * \text{Technology}$$

Where,

Affluence is measured as the per capita GDP

Technology is in terms of energy intensity and carbon intensity.

The increasing population and GDP accounted for an increase in the carbon emissions; this was however compensated by the declining energy intensity and less carbon intensive fuel use. The growth showed a declining trend during 1974-76 and 1979-82 due to high oil prices and then during 1990-94 during the transformation of Soviet Union. The contribution to the world emission by the countries is affected in the following order- OECD, Asia, REF and ALM regions.

Asia's Contribution:

Bangladesh- The growth in the carbon emission is 7% per annum and is attributed to high energy-GDP ratio, increase in population and per capita income. The increase in energy intensity has been due to the replacement of biomass with energy efficient fuels. The energy intensity will however decrease thereby increasing the carbon emissions, though at a slow rate. The future contributor to increased emissions is predicted to be the affluence as the population growth is likely to decrease.

China- China's contribution is likely to increase due to an increase in the economic activity. Emission reduction was observed after 1978 due to improved energy efficiency and import of energy efficient products. Increasing population contributed 595 million tons of carbon by the year 1995. Carbon intensity is however likely to decrease due to the use of hydro energy.

India- Contributors to carbon emissions in India are population growth and the increase in per capita GDP. The economic growth will 4% and the population growth at about 1.9% annually. The increase in efficient end use will decrease the energy intensity.

Indonesia, Thailand and South Korea- The per capita income growth is responsible for increase in emissions in all three countries. Another reason being the population growth for S. Korea and Thailand and the energy intensity in Indonesia. Emissions are likely to reduce due to the replacement of fuel mix with natural gas and increased share of oil for transportation.

Latin America's Contribution

Brazil- The economic and population growth are responsible for increase in emissions. They are however compensated by the use of hydro and natural gas use, which reduces the emissions.

Mexico- CO₂ emissions are predicted to be slow due to the decline in energy intensity.

Venezuela- The emission increase is at the rate of 2.6% annually and is mainly due to the population increase in addition to the energy intensity.

Impact on Developing World:

The developing countries will face the brunt of climate change more than the developed countries. These countries are more vulnerable to climate change due to their geographical location, their population growth and their economic status. The developing countries usually depend on agriculture as their main source of revenue. The agriculture in turn depends on the rainfall. In addition to this the demand for food is also increasing

due to the increasing population growth rate. All this ultimately leads to a low per capita income. Thus by the end of it, the economic situation of the countries is not good enough to handle a sudden change in the climate or an extreme event. Therefore, the developing countries are found to suffer the maximum.

Africa: The African population in 1997 was 778 million and is projected to be 1453 million by the year 2025. 40% of this population lives below the poverty line due to inadequate food production. The production of crops has been affected due to land degradation and due to the dependence of farming on rainfall. Only about 6% of the cultivated area is irrigated. To add to this, the occurrence of droughts could seriously affect the availability of food. The climate change will worsen the food security through increased extremes and potential declines in soil moisture. **Asia:** Population in Asia in 1997 was 3559 million and is projected to increase to 4784 million by 2025. The growth has been at the rate of 1.4% and, that for South and SE Asia 1.9% and 1.7% respectively. Asia also comprises of countries with high population densities like Bangladesh (922 persons/km²) and India (320 persons/km²). Asia comprising of 60% of the world's population is dependent on 1/3rd of the world's land area. This indicates the low per capita land available. This results in low crop production, which further reduces due to soil erosion and inefficient agricultural practices. Decrease in agriculture and aquaculture is also attributed to thermal and water stress, sea level rise, floods, droughts and tropical cyclones. It is predicted that yields in China will decline and wheat and rice production will be affected in India due to combined water and thermal stress.

Latin America: The population was estimated to be 498 million in 1998 and is projected to reach 625 million by 2015. In spite of having the world's largest reserve of cultivable land, the food production is likely to be affected due to land degradation. 250 Mha of the land is affected by land degradation, soil erosion being a major factor. 100 Mha of land has been degraded due to deforestation and 70 Mha due to over-grazing. In addition to the effects on food production, climate change will also affect the forest ecosystems and water resources. 65 Mha of forests were lost between 1990-95. Climate change will

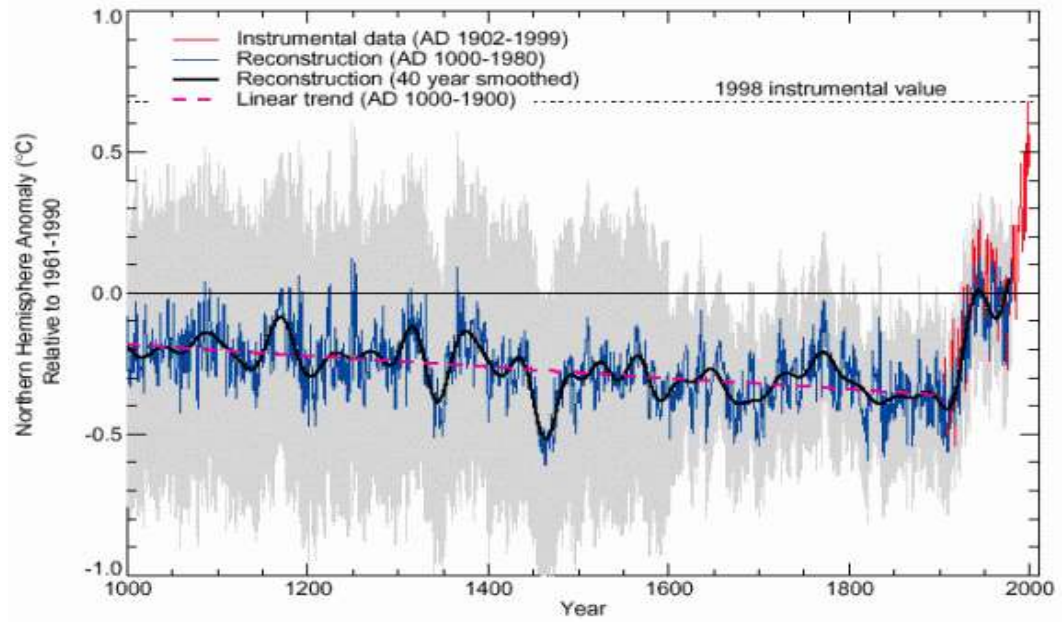
transform the geographic location of the ecosystem, modify the mix of species and limit their ability to provide a range of products to the local population. Projections by the GCMs indicate detrimental effects on hydrological balance in Sahel and Southern Africa. HadCM3 scenario projects reduction in stress in Indian sub-continent by 2050, thereby reducing the water stress. A decrease is projected for Australia, India, and Southern Africa, most of South America and Europe and increase for North America, Central Asia and Central eastern Africa.

The incidence of occurrence of diseases is also projected to increase. An increase in temperature and climate variability will alter the seasonal occurrence as well as spatial distribution of the disease causing vectors. A high risk is projected for China and Central Asia. Low-income groups will be highly susceptible to the spread of these diseases. Increased occurrence of natural hazards will further add to their plight.

Unmitigated sea level rise of 40 cm is projected for the future. This will lead to increased occurrence of floods and the number of flood affected people will rise from 13 million to 94 million as 60% of the population occupies the coastal regions of Southern Asia, countries like, India, Pakistan, Sri Lanka, Bangladesh, Myanmar and 20% in SE Asia, including Thailand, Indonesia, Philippines and Vietnam. The coastal wetlands of Mediterranean, Baltic and Atlantic coast of North and Central America appear to be vulnerable to sea level rise.

Rise in sea levels and the occurrence of extreme events may also affect the developing countries with weak coastal defense system in terms of migrations, both internal and international. Land losses due to inundation will range from 80% in Majuro, in Marshall Islands, 17.5% in Bangladesh, 6% in Netherlands and 1% in Egypt. As seen from the studies by the IPCC, the countries most vulnerable to a change in the climate are the developing and under developed countries. These countries will be unable to adapt to the sudden changes in the climate due to their large population and poor economic status. Therefore, efforts should be made to provide sufficient aid to them.

Temperature Variations Computed from Tree Ring Data



Source: www.vision.net.au

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