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CLIMATE CHANGE: CHALLENGES TO SUSTAINABLE DEVELOPMENT IN INDIA

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NEW DELHI

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PREFACE

This publication titled "Climate Change: Challenges to Sustainable Development in India" is the next in a series of 'Occasional Papers' proposed to be brought out on topical issues from time to time for the benefit of the Members of Parliament.

This paper seeks to present varied dimensions and impacts of climate change, highlighting India's response to meet the challenges of climate change. The climate friendly measures taken by India in the overall perspective of the developing countries have also been underlined.

I am grateful to eminent experts namely, Prof. M. S. Swaminathan, MP, Shri N.K. Singh, MP and Dr. R. K. Pachauri, Chairman, IPCC and Director-General, The Energy and Resources Institute (TERI) whose valuable suggestions have greatly enriched the contents of this paper.

It is hoped that Members would find this paper interesting and useful.

NEW DELHI
16 *October,* 2008

V. K. AGNIHOTRI
Secretary-General
Rajya Sabha

CLIMATE CHANGE: CHALLENGES TO SUSTAINABLE DEVELOPMENT IN INDIA

I

Introduction

Climate change is one of the complex problems facing mankind today. The overriding complexity of the problem is attributed to its deeper global ramifications on a vast range of issues impacting the very survival of life on Earth. Understanding such a complex issue with vast and varied dimensions and implications, assumes greater significance for all stakeholders, especially for our policy makers. There are varieties of perceptions regarding the exact size and consequences of climate change. Yet, it is no secret that risks emanating from climate change are indeed profound, which call for urgent mitigation. There is now strong evidence that climate change is a reality.[1] Today, it has been scientifically established that significant global warming is occurring. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.[2] There is no denying the fact that the problem exists and it is assuming alarming proportions, each passing day. Therefore, there is an imperative need to take urgent and strong measures in the interest of calibrating an appropriate response to meet the emerging challenges of climate change.

Climate change is not an isolated issue. It has several aspects and inter-linkages namely, science and technology, economy and trade, diplomacy and politics - that makes it not just another issue in this complicated world of proliferating issues, but the mother of all issues. Climate change, however, is different from other problems facing humanity and it compels us to think differently at many levels. It obliges us to think about what it means to live as part of an ecologically interdependent human community. In the face of many diversities that characterize human society, climate change provides a potent reminder of one thing that we share in common - the planet Earth. All nations and all people share the same atmosphere. And, we only have one. Addressing the climate chaos by all the countries both individually and collectively, will be critical to the human well-being and prosperity of the present as well as the future generations.

Understanding Climate Change

Climate change refers to the variation in the Earth's global climate or in regional climates over time. It describes changes in the state of the atmosphere over time scales ranging from decades to millions of years. Climate change

[1] Joint statement by 11 national science academies from Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, U.K. and USA to world leaders, 7 June, 2005

[2] Climate Change 2007, Synthesis Report (A Report of the IPCC), p.2

has been defined by many in many ways. While some define it as an offshoot of Earth's natural processes, others define it as a result of human activities. Striking a balance between these two varying perspectives, climate change is defined as "a change which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".[3] Truly, the present changes in the Earth's climate cannot be explained alone by the natural processes that explain Earth's previous warm periods. There is a broad scientific consensus that most of the warming in the recent decades can be attributed to human activities.[4] If humanity is, in large part, responsible for this change, then whatever choices we make today, will have a significant bearing on the climate of the future. This makes climate change a formidable concern.

Greenhouse Gases and Global Warming

The Earth's climate is dynamic and always changing through a natural cycle. It took billions of years for the Earth's climate to become conducive for the evolution of mankind. The solar energy, passing through the atmosphere, is absorbed by the Earth's surface and a significant part of it is reflected back into the atmosphere. However, the atmosphere of the Earth contains small quantities of carbon dioxide, methane and nitrous oxide (collectively called greenhouse gases (GHGs)) which act as a partial blanket that trap some of the outgoing infra red radiation and reflect it back to Earth thus keeping the surface warmer than it would otherwise be. In the absence of this greenhouse effect (trapping by GHGs) the Earth's mean temperature would be 30°C lower than it is,[5] which would mean that the Earth would be an ice covered place. Thus, most of the present life forms on the Earth depend on the natural greenhouse effect for their existence.

However, increase in the emission of these GHGs due to human activities causes the *enhanced greenhouse effect.* Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004.[6] Apart from the three natural GHGs (carbon dioxide, methane and nitrous oxide), the increased emission also includes several "man-made" gases including chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6).[7] Increase in the concentration of these GHGs tends to increase the surface temperatures. This rise in the average temperature of the Earth is called global warming, which is likely to lead to unprecedented climate changes on a global scale threatening the ecosystems of the entire world.

Today, there is evidence that we are overloading the carrying capacity of the Earth's atmosphere. Stocks of greenhouse gases that trap heat in the Earth's atmosphere are accumulating at an unprecedented rate. Today, increasing

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[3] Article 1, United Nations Framework Convention on Climate Change
[4] Inter-Governmental Panel on Climate Change (IPCC), Third Assessment Report, 2001
[5] Coping with Climate Change: Gautam Dutt and Fabiina Gaioli (EPW, 20 Oct, 2007, p.4239)
[6] Climate Change 2007, Synthesis Report (A Report of the IPCC), p.5
[7] *Ibid*

number of scientists believe that we have already crossed into a new weather regime marked by extremes of all kinds.[8] It is predicted that in the course of the 21st Century, average global temperature could increase by more than 5°C. Behind this prediction, there is an overwhelming fact that we are playing havoc with our environment, upsetting the ecological interdependence. In effect, our generation is compelling future generations to inherit an unsustainable ecological debt, which will jeopardize the future development and prosperity.

[8] Ross Gelbspan, "Addressing Climate Chaos", in *Surviving the Century,* edited by Herbert Girardet, Earthscan, London, 2007

II

Dimensions of Climate Change

The starting point for averting the dangers of climate change is to recognize the distinctive dimensions of the problem. These are:

(i) Long-term Consequences of GHGs

An important dimension is that carbon dioxide and other greenhouse gases stay in the atmosphere for a long time. There are no rewind buttons. People living in the next century will live with the harmful consequences of our emissions. Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if GHG concentrations were to be stabilized.[9] Even firm measures will not materially affect average temperature changes. The world will have to live with the deleterious consequences of climate change, which we are already facing.

The Human Development Report 2007 has succinctly presented the issue of climate change in a perspective. It states:

What we do today about climate change has consequences that will last a century or more. The part of that change that is due to greenhouse gas emissions is not reversible in the foreseeable future. The heat trapping gases we send into the atmosphere in 2008 will stay there until 2108 and beyond. We are therefore making choices today that will affect our own lives, but even more so the lives of our children and grandchildren. This makes climate change different and more difficult than other policy challenges.

(ii) Need for Quick Response

A sense of urgency is another dimension of the challenges posed by climate change. With climate change, every year of delay in reaching an agreement to cut emissions adds to greenhouse gas stocks, locking the future into a higher temperature.

(iii) Global Climatological Effect

Another important dimension of the climate change challenge is its global scale. The Earth's atmosphere does not differentiate greenhouse gases by country of origin. One tonne of greenhouse gases from China carries the same weight as one tonne of greenhouse gases from the United States—and one country's

[9] Climate Change 2007, Synthesis Report (A Report of the IPCC), p.12

emissions are another country's climate change problem. It amply demonstrates that no one country can win the battle against climate change on its own. Collective action is not an option but a compulsion. But ultimately, this is a preventable crisis that threatens all people and all countries. We have the choice between forging ahead collectively with a shared perspective or hanging separately. Our choice will determine our ability to find solutions to the climate change concerns.

(iv) Commitments of the Developed vs. Developing Countries

Another significant dimension of climate change pertains to the varying commitments of the developed and developing countries. The challenge to limit and cut emissions and to adapt to climate changes is upon all of us, depending on the common but differentiated responsibilities of countries to take action. The United Nations Framework Convention on Climate Change (adopted at the Rio Earth Summit in May 1992) aimed at achieving stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.[10] As a first step, the Convention called upon the developed countries to restrict their green house gas emissions to 1990 levels by 2000. In reality, emissions from these countries, as a whole, have increased since 1990. Between 1990 and 2005, green house gas emissions continued to rise in 26 out of a total of 40 developed countries.[11] Correspondingly, the emissions of the economies in transition fell by 39 per cent during the Nineties due to sharp decline in the levels of their economic activities.

It is apparent that quantified emission reduction commitments from the developed countries can only achieve real cuts in green house gas emissions. In 1997, parties to the UNFCCC adopted the Kyoto Protocol to strengthen the commitment of the developed countries towards carbon emissions reduction. Kyoto Protocol is viewed as one of the significant measures in the reduction of carbon emissions of the developed countries, yet the USA – the world's largest emitter of greenhouse gases, has not ratified it, raising serious doubts in the effectiveness of this protocol. Under Kyoto protocol, even though there is an obligation on the part of the developed countries to commit themselves to a second round of quantified emission reductions for the next decade (the present commitments expire in 2012), they have maintained a deafening silence over this issue. Rather, their intention seems to escape from the quantitative emission reduction commitments that are obligatory for the developed countries under the Kyoto protocol and to introduce, at the same time, new commitments for the developing countries – in particular, the so called emerging economies such as China, India, Brazil and South Africa.[12]

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[10] Article 2, United Nations Framework Convention on Climate Change

[11] Chandrashekhar Dasgupta, 'Shifts on Climate Change', *The Telegraph*, Calcutta, 2 September, 2008

[12] *Ibid*

Under the Climate Convention, the developing countries have also a set of commitments. The Convention states that "the extent to which developing country parties will effectively implement their commitments under the Convention will depend on the effective implementation of the developed country parties of their commitments under the Convention related to financial resources and transfer of technology. This has to take into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country parties. The Convention recognizes greater responsibility on the part of the developed countries towards the largest share of historical and current share of emissions of GHGs as also their greater capacity than the developing countries to meet the costs of the global response to climate change challenge. As the present trend shows, the developed countries instead of meeting their own obligations, are endeavouring to pass the buck to the developing countries. But for the developing countries, sacrificing economic growth at the altars of emissions reduction is certainly not a priority.[13] They are keen to cope with current and future conditions through economic growth and development. Unless, this issue is mutually addressed, global response towards finding a sustainable solution to the problems of climate change will be seriously impeded.

(v) Climate Change and the World's Poor

In fact, the scientific community has already perceived the early warning signs, which are now being noticed even by a lay man. Vulnerability to climate has a strong linkage with poverty. Across developing countries, millions of the world's poorest people are already being forced to cope with the impacts of climate change. Increased exposure to severe droughts, intense storms, devastating floods and lasting livelihood insecurity is proving to be a major roadblock, holding back the efforts of the world's poor to build a better life for themselves and their children.

The underlying point is that the manner in which the world addresses the concern of climate change today will have a direct bearing on the human development prospects of poor, especially in the developing countries. Lack of vision and prudence to deal with the problem will relegate the poorest 40 per cent of the world's population—some 2.6 billion people—to a future of diminished opportunity. It will exacerbate deep inequalities within countries and reinforce the vast disparities between the 'haves' and the 'have-nots', thus undermining efforts to build an inclusive and egalitarian world order.

Today, it is the poor who are bearing the brunt of global warming and climate change. Tomorrow, it will be humanity as a whole. The rapid build-up of greenhouse gases in the Earth's atmosphere is fundamentally changing the climate forecast for future generations. These are fairly unpredictable events with potential to engender ecological catastrophes and demographic dislocations, transforming human settlement patterns and undermining the viability of national economies.

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[13] Franklin Cudjoe and Bright Simons, 'UN climate change plans and world's poor', *The Pioneer,* 9 September, 2008

Jeffrey Sachs, an eminent Economist, has made some insightful observations on the profound linkage between economics and the environment, commending the humanity to address global problems on a global scale. He holds that the world's population, climate change, poverty and resource-use are all closely intertwined. One-sixth of the world remains trapped in extreme poverty unrelieved by global economic growth. The poverty trap poses tragic hardships for the poor themselves and great risks for the rest of the world.[14]

The world's poor, it is predicted, will suffer the earliest and most damaging impacts of climate change. It is a sheer irony that rich nations and their people account for the overwhelming bulk of the greenhouse gases; however, poor countries and their people continue to pay a heavy price for climate change. While the world's poor walk the Earth with a light carbon footprint, they are bearing the brunt of unsustainable management of our ecological interdependence. In rich countries, coping with climate change has largely been a matter of adjusting thermostats, dealing with longer and hotter summers, and observing seasonal shifts. The future risks facing cities in the rich countries will be marginal. But, the real climate change vulnerabilities linked to storms and floods are being found in rural communities in the great river deltas of the Ganges, the Mekong and the Nile, and in sprawling urban slums across the developing world.

The emerging risks and vulnerabilities associated with climate change are the outcomes of physical processes. They are also, at the same time, a consequence of human actions and choices.[15] This realization should bring moral responsibilities, including responsibilities to reflect upon and change energy policies that inflict harm on the vulnerable sections of humanity in the present as also future generations.

(vi) Climate Change, Trade and Trade Protectionism

There have been specific issues and tensions that keep on arising between international trade and the climate change regime in international trade negotiations. A range of international trade disputes about climate change measures have taken place, which would pose a very serious challenge to achieving a mutually supportive relationship between trade and climate change policies. The trade-and-climate-change debate is also expanding the notion of what constitutes "unfair" trade. For decades, international trade law, as reflected in both the WTO system and the domestic law of most trading nations, has recognized that pricing imports below certain levels (whether due to "dumping" by foreign exporters or subsidies provided by foreign governments) is a form of "unfair" trade that should be redressed where it harms domestic industries. This notion of unfair trade is based purely on how an imported product is priced. Climate change concerns are now expanding the notion of unfair trade to take into account how imported products are made - specifically, the volume and nature of the greenhouse gases associated with their manufacture.

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[14] Jeffrey D. Sachs, '*Common Wealth: Economics for a Crowded Planet'*, Allen Lane, 2008, p.6
[15] Human Development Report, UNDP, 2007/2008, p.18

In the name of combating climate change, another aspect of unfair trade is manifested through protectionist measures. Some of the tools being advocated and used to address climate change, particularly in Europe appear to be quite outlandish. There is a concept known as **'food miles'**, which is a measure of how far food travels from farm to home. In Europe, there is a consumer-led campaign based on the notion that the further a food product travels, the greater would be the damage to the environment. Consumers are being encouraged to purchase products produced closer to home, fueling protectionism under the guise of environmental concern for climate change. However, according to the UK Department for the Environment, Food and Rural Affairs (DEFRA) the 'food miles' concept is flawed because it only focuses on the distance traveled by food, which is not an adequate indicator of sustainability.[16]

Non-compliance of carbon emissions reduction has also triggered protectionist sentiments. The European Union (EU) is threatening unilateral trade measures that could restrict imports as part of its ambitious drive to reduce carbon emissions across a wide range of industries by 20 per cent by 2020. EU leaders have repeatedly referred to the possibility of imposing a carbon tax or allowance on imports from countries that are not in compliance with Kyoto Protocol emission reduction requirements. These suggestions have drawn strong criticism from U.S. trade officials, who warn that these proposals could facilitate WTO-inconsistent trade protectionism under the guise of environmental protection.[17]

Another disturbing trend which is brazenly manifesting in trade negotiations between the developed and the developing countries, pertains to competitive concerns. In an effort to remain competitive in a global market where increasing demands are made by consumers for 'green' products, there is a constant pressure on the developing countries to determine the environmental impact of their industries. Regardless of any scientific basis, the developed countries hold that exported products from the developing world have a higher environmental cost. In the guise of environmental concern, they promote trade protectionism. The same argument was also vigorously advanced by the developed countries in the multilateral trade negotiations in respect of labour standards of the developing countries. Protectionist barriers to trade are being created in the name of environment and labour standards, which have the potential to frustrate the development aspirations of poorer countries. There is a need to create a balance as to how investment and trade can protect the environment without encouraging protectionism by the industrialized world.

Linked with this is an imperative need to remove the discriminatory features of multilateral trade negotiations and to enhance their acceptability among all the stakeholders. Lest, it would encourage the countries, both the developed and the developing ones, to embrace the new paradigm of Preferential Trade Agreements (PTAs). The European Union (EU), the North Atlantic Free Trade Agreement (NAFTA), the Association of South-East Asian Nations (ASEAN),

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[16] Executive Summary of the Report on 'The Validity of Food Miles as an Indicator of Sustainable Development,' UK Department for the Environment, Food and Rural Affairs (DEFRA), July, 2005

[17] 'Trade Law and Climate Change: Convergence or Conflict?', Bernd G. Janzen Akin Gump Strauss Hauer & Feld LLP (*www.metrocorpcounsel.com/current)*

etc. have had created large trading blocks, spurring others on the same path. There are relative merits and demerits of a country entering into any Preferential Trade Agreement. However, it is apprehended that the alliance between PTA countries could create stronger protectionist lobbies which may be more difficult to dismantle; these protectionist groups may become politically more formidable. By locking a country into an inefficient production pattern, it handicaps its ability to adjust to a structure that would be more competitive under global free trade.[18]

Trade protectionism per se is antithetical to the spirit of global free trade and sustainable development. An open and transparent international economic system with a long-term commitment to sustainable development is, however, key for a rapid diffusion of new climate change-related knowledge and technologies and for lower aggregate costs of stabilizing greenhouse gas concentrations in the atmosphere at a level that may suffice to prevent dangerous anthropogenic interference with the climate system.[19]

(vii) Climate Change and Business and Industry Environment

An interface between climate change and present day business is another important dimension. To effectively meet the challenges of climate change, the business and the industries, especially in the manufacturing sector, need to reduce GHGs emissions. They need to undertake carbon trading by investing in the environment-friendly technologies, besides putting in place clean development mechanisms. In order to retain competitiveness of products in a rapidly changing global economy, they need to eschew energy intensive products and processes and adopt environment friendly changes in their practices, promoting energy efficient technologies, newer greener manufacturing methods, etc.[20]

(viii) Economics of Climate Change

In addition to being a serious environmental issue, climate change entails a social and economic cost as well. The issue becomes more complex, as the climate change impacts the whole of globe. The Stern Review on *the Economics of Climate Change*, assesses the effect of climate change and global warming on the world economy and explores the economics of stabilizing the greenhouse gases in the atmosphere. The Review concludes that solution to climate change may be affordable - may be more affordable than the costs of inaction. It suggests that mitigation must be viewed as an investment, a cost incurred now and in the coming few decades to avoid the risks of very severe consequences in the future. The current cost of averting climate chaos amounts about 1 per cent of the world's GDP, whereas the costs of inaction could be about 20 times that amount.[21] The Stern Review also considers the complex policy challenges involved in managing the transition to a low-carbon economy and in ensuring

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[18] N.K. Singh, Preferential Trade Agreements: Stumbling Blocks or Building Blocks?, *The Indian Express,* April 24, 2005

[19] Intergovernmental Panel on Climate Change, Third Assessment Report, Working Groups III "Mitigation of Climate Change", Summary for Policy Makers, 2001

[20] Carbon Market: Emerging Sectors and Trends, ASSOCHAM, 2008, p.9

[21] The Stern Review, www.hm-treasury.gov.uk

that societies can adapt to the consequences of climate change that can no longer be avoided.

The Report has further stated that three elements of policy for mitigation are essential: carbon pricing, technology policy, and the removal of barriers to behavioural change.

(a) Carbon Pricing

Establishing a carbon price, through tax, trading or regulation, is an essential foundation for climate-change policy. Greenhouse gases are, in economic terms, an externality: those who produce greenhouse-gas emissions are bringing about climate change, thereby imposing costs on the world and on future generations, but they do not face the full consequences of their actions themselves.

Therefore, putting an appropriate price on carbon – explicitly through tax or trading, or implicitly through regulation – would imply that people are faced with the full social cost of their actions. This will lead individuals and businesses to switch away from high-carbon goods and services, and to invest in low-carbon alternatives.

(b) Technology Policy

The second element of climate change policy is technology policy, covering the full spectrum from research and development, to demonstration and early stage deployment. The development and deployment of a wide range of low-carbon technologies is essential in achieving the deep cuts in emissions that are needed.

The current scenario is that many low-carbon technologies are currently more expensive than the fossil-fuel alternatives. Carbon pricing gives an incentive to invest in new technologies to reduce carbon; indeed, without it, there is little reason to make such investments.

(c) Behavioural Change

The barriers to behavioural change include a lack of reliable information, transaction costs, and behavioural and organizational inertia, which need to be removed in the interest of energy efficiency. The impact of these barriers can be most clearly seen in the frequent failure to realise the potential for cost-effective energy efficiency measures. Policies, including labelling and the sharing of best practices, can help consumers and businesses make sound decisions, and stimulate competitive markets for low-carbon and high-efficiency goods and services.

(ix) National Energy Policies and Climate Change

Climate change, caused primarily by our reliance on fossil fuels for energy is a frightening challenge facing humanity, this century. The way the countries

of the world address this problem will have massive ramifications for the global society, economy and environment. Climate change, therefore, needs to be factored into every decision of the governments, especially in all decisions pertaining to the energy policies. All countries need to have a proactive and forward looking energy policy, which progressively facilitates the smooth transition from the current unsustainable fossil fuel energy system to an ecologically and economically sustainable system based on alternative sources of energy. The overall challenge is an energy "revolution", a restructuring of our economies, in order to "de-carbonise"[22] .

Worldwide, fossil fuels are the most heavily subsidised energy sources, totalling an estimated USD 180 to 200 billion per year. There are some who hold that the bulk of energy subsidies worldwide result in a lower price for fossil fuels to end users, causing more of those fuels to be consumed, increasing carbon-dioxide and other greenhouse-gas emissions and contributing to climate change[23] . Therefore, they call for reform in the national energy policies with a focus on efficient and sustainable energy pricing. According to this perception, "efficient energy pricing is the inescapable principle on which rests the future of sustainable economic growth"[24] .

There is also a counter view, which suggests that only reduction of fossil fuel subsidies cannot be a viable deterrent of energy-intensive activities and carbon emissions. In the developed countries, increase in per capita income and enhanced standards of living of the people have, to a great extent, resulted in intensive use of fossil fuel and other high energy intensive activities. Change in the pattern of energy usage could be effected more by a change in the life style and change in the outlook, but certainly not by reducing the subsidies.

In the interest of sustainable energy security, all countries need to pursue the goal of efficient energy pricing, keeping in view the objective conditions prevalent in their economies. But, bringing about reform in energy pricing is not an easy task. Implementing energy-subsidy reforms remains a formidable challenge, as in many instances, governments have been faced with social and economic compulsions, besides strong resistance from the affected sections and their advocacy bodies. The endeavour should be to prioritise the state subsidies in a way so as to support more of the renewable energy sources and energy-efficient technologies, which would eventually help reduce greenhouse-gas emissions. Targeted subsidies to clean energy can play an important role in reducing emissions.

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[22] Keynote speech by Angel Gurría, OECD Secretary-General, during the World Energy Council Energy Leaders Summit, London, 16 September 2008

[23] Energy Subsidies: Their Magnitude, How they Affect Energy Investment and Greenhouse Gas Emissions, and Prospects for Reform, Final Report, UNFCCC Secretariat,10 June 2007

[24] N.K.Singh, '*The Politics of Change: A Ringside View',* New Delhi: Penguine Viking, 2007, p. 124

III

Impacts of Climate Change

Though climate change poses a variety of challenges, the present paper would specifically focus on the issues *viz*. agriculture and food security, water stress and water insecurity, rising sea levels, biodiversity and human health, which have immense relevance from the perspective of developing countries in general and India in particular.

(i) Agriculture and Food Security

Climate Change is projected to have significant impacts on conditions affecting agriculture, including temperature, precipitation and glacial run off. It affects agriculture in more ways than one. It can affect crop yield as well as the types of crops that can be grown in certain areas, by impacting agricultural inputs such as water for irrigation, amounts of solar radiation that affect plant growth, as well as the prevalence of pests.

Rise in temperatures caused by increasing green house gases is likely to affect crops differently from region to region. For example, moderate warming (increase of 1 to 3 ^{o}C in mean temperature) is expected to benefit crop yields in temperate regions, while in lower latitudes especially seasonally dry tropics, even moderate temperature increases (1 to 2 ^{o}C) are likely to have negative impacts for major cereal crops. Warming of more than 3 ^{o}C is expected to have negative effect on production in all regions.[25] The Third Assessment Report of the IPCC, 2001 concluded that climate change would hit the poorest countries severely in terms of reducing the agricultural products. The Report claimed that crop yield would be reduced in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect/pest incidence. In South Asia losses of many regional staples, such as rice, millet and maize could top 10 per cent by 2030.[26]

As a result of climate change the amount of arable land in high-latitude region is likely to increase by reduction of the amount of frozen lands. At the same time arable land along the coast lines are bound to be reduced as a result of rising sea level. Erosion, submergence of shorelines, salinity of the water table due to the increased sea levels, could mainly affect agriculture through inundation of low lying lands.

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[25] IPCC Fourth Assessment Report, 2007, p.38

[26] Climate Change and Agriculture (http:en.wikipedia.org/wiki/Climate-change-and-agriculture)

In a recent study, the International Commission for Snow and Ice (ICSE) reported that Himalayan glaciers – that are the principal dry-season water sources of Asia's biggest rivers - Ganges, Indus, Brahmaputra, Yangtze, Mekong, Salween and Yellow – are shrinking quicker than anywhere else and that if current trends continue they could disappear altogether by 2035.[27] If the predictions are true then the magnitude of the impact can be gauged from the sheer numbers of people it will affect. Approximately 2.4 billion people live in the drainage basin of the Himalayan Rivers. The above predictions certainly pose a serious threat to agriculture which impacts human lives in many ways. One of the foremost impacts is food security.

Agriculture is important for food security in two ways: it provides the food and also the primary source of livelihood for 38.7 percent of the world's total workforce. In Asia and the Pacific, this share accounts for approximately 50 per cent and in sub-Saharan Africa, nearly two-thirds (63 per cent) of the working population still make their living from agriculture.[28] If agricultural production in the low-income developing countries of Asia and Africa is adversely affected by climate change, the livelihoods of large numbers of the rural poor will be put at risk and their vulnerability to food insecurity will be manifold.

(ii) Impacts on Indian agriculture

Agriculture is the mainstay of Indian economy and provides food and livelihood security to a substantial section of the Indian population. The impact of climate change as witnessed in recent times has immense potential to adversely affect agriculture in this country in a variety of ways. As a large part of the arable land in India are rain-fed, the productivity of agriculture depends on the rainfall and its pattern. Agriculture will be adversely affected not only by an increase or decrease in the overall amounts of rainfall but also by shifts in the timing of the rainfall. Any change in rainfall patterns poses a serious threat to agriculture, and therefore to the economy and food security. Summer rainfall accounts for almost 70 per cent of the total annual rainfall over India and is crucial to Indian agriculture. However, studies predict decline in summer rainfall by the 2050s.[29] Semi arid regions of western India are expected to receive higher than normal rainfall as temperatures soar, while central India will experience a decrease of between 10 and 20 per cent in winter rainfall by the 2050s.[30] Relatively small climate changes can cause large water resources problems particularly in arid and semi arid regions such as northwest India.

Productivity of most crops may decrease due to increase in temperature and decrease in water availability, especially in Indo-Gangetic plains. This apart, there would be a decline in the productivity of *rabi* as compared to *kharif* season

[27] Khoday, Kishan, 2007 Climate Change and the Right to Development: Himalayan Glacial Melting and the future of Development on the Tibetan Plateau UNDP-Human Development Report 2007/2008)

[28] Global Employment Trends: Brief (ILO, January 2007, p.12)

[29] Climate Change and its Impact on India (http://www.greenpeace.org/india/campaigns/choose-positive-energy/what-is-climate-change...)

[30] Impacts of Climate Change: Western and Central India (www.cseindia.org/programme/geg/pdf/western.pdf)

crops. Rising temperature would increase fertilizer requirement for the same production targets and result in higher GHG emissions, ammonia volatilization and cost of crop production.[31] Increased frequencies of droughts, floods, storms and cyclones are likely to increase agricultural production variability. Therefore, we have to place equal emphasis on saving lives and sustaining livelihoods[32].

(iii) Water Stress and Water Insecurity

Lack of access to water is a perturbing issue, particularly in developing countries. At present a whopping 1.1 billion people around the world lack access to water and 2.6 billion people are without sanitation. Climate change is expected to exacerbate current stresses on water resources. By 2020, between 75 and 250 million people are projected to be exposed to increased water stress due to climate change.[33]

Spreading water scarcity is contributing to food insecurity and heightened competitions for water both within and between countries. As the world population expands and the consumption of water spirals upwards, water problems are bound to intensify. By 2025, 40 per cent of the world's population, more than 3 billion in all, may be living in countries experiencing water stress or chronic water scarcity.[34]

Increase in temperature due to climate change has been widespread over the globe. Warming has resulted in decline in mountain glaciers and snow cover in both hemispheres and this is projected to accelerate throughout the 21st century. This will in turn lead to reducing water availability, hydropower potential, and would change the seasonal flow of rivers in regions supplied by melt water from major mountain ranges (*e.g.* Hindu-Kush, Himalaya, Andes) where more than one-sixth of the world population currently lives.[35] By 2050s freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease.[36]

A warmer climate will accelerate the hydrologic cycle, altering rainfall, magnitude and timing of run-off. Available research suggests a significant future increase in heavy rainfall events in many regions, while in some regions the mean rainfall is projected to decrease. The frequency of severe floods in large river basins has increased during the 20th century and it is likely that up to 20 per cent of the world population will live in areas where river flood potential could increase by the 2080s.

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[31] *Effect of Global Warming on Crop Productivity*, Y.S. Shivay and Anshu Rahal, *Kurukshetra*, July 2008, p.19

[32] M.S. Swaminathan, For an Action Plan for Bihar, *The Hindu*, 5 September, 2008

[33] Climate Change 2007: Synthesis Report, IPCC, p.11, Geneva

[34] Water Conflicts Loom as Supplies Tighten; Food Security Threatened, Ecosystems in Decline (http://www.worldwatch.org/node/1600)

[35] Climate Change 2007: Impacts, Adaptation and Vulnerability (Fourth Assessment Report of the IPCC, Geneva, 2007, p.11)

[36] Climate Change 2007, Synthesis Report, p.11

Increasing floods poses challenges to society, physical infrastructure and water quality. Rising temperatures will further affect the physical, chemical and biological properties of fresh water lakes and rivers, with predominantly adverse impacts on many individual fresh water species, community composition and water quality. In coastal areas, sea level rise will exacerbate water resource constraints due to increased salinisation of groundwater supplies.

(iv) Impacts on water situation in India

India stands to face major challenges in many fronts in so far as the impact of climate change is concerned. Water security is one of the most important threats in this regard. Water resources will come under increasing pressure in the Indian subcontinent due to the changing climate.

The Himalayan glaciers are a source of fresh water for perennial rivers, in particular the Indus, Ganga, and Brahmaputra river systems. In recent decades, the Himalayan region seems to have undergone substantial changes as a result of extensive land use (e.g. deforestation, agricultural practices and urbanization), leading to frequent hydrological disasters, enhanced sedimentation and pollution of lakes. There is evidence that some Himalayan glaciers have retreated significantly since the 19th century.[37] Available records suggest that the Gangotri glacier is retreating about 28 m per year. Any further warming is likely to increase the melting of glaciers more rapidly than the accumulation. Glacial melt is expected to increase under changed climate conditions, which would lead to increased summer flows in some river systems for a few decades, followed by a reduction in flow as the glaciers disappear.

As a result of increase in temperature significant changes in rainfall pattern have been observed during the 20th century in India. A serious environmental problem has also been witnessed in the Indo-Gangetic Plain Region (IGPR) in the past whereby different rivers (including Kosi, Ganga, Ghaghara, Son, Indus and its tributaries and Yamuna) changed their course a number of times. The recent devastating floods in Nepal and Bihar due to change of course of River Kosi is a case in point.

Available study suggests that food production has to be increased to the tune of 300 mt by 2020 in order to feed India's ever-growing population, which is likely to reach 1.30 billion by the year 2020. The total foodgrain production has to be increased by 50 per cent by 2020 to meet the requirement. It is feared that the fast increasing demand for food in the next two or three decades could be quite grim particularly in view of the serious problem of soil degradation and climate change.

The rise in population will increase the demand for water leading to faster withdrawal of water and this in turn would reduce the recharging time of the water-tables. As a result, availability of water is bound to reach critical levels sooner or later.

During the past four decades, there has been a phenomenal increase in the growth of groundwater abstraction structures. Growing demand of water in

[37] The Day After Tomorrow: Impact of Climate Change on the World's Water, Dr. Pradipto Ghosh, *Terragreen*, 2008, p.9

agriculture, industrial and domestic sectors, has brought problems of over-exploitation of the groundwater resource to the fore. The falling groundwater levels in various parts of the country have threatened the sustainability of the groundwater resources.

At present, available statistics on water demand shows that the agriculture sector is the largest consumer of water in India. About 83% of the available water is used for agriculture alone. If used judiciously, the demand may come down to about 68% by the year 2050, though agriculture will still remain the largest consumer. In order to meet this demand, augmentation of the existing water resources by development of additional sources of water or conservation of the existing resources and their efficient use will be needed.

It is evident that the impact of global warming threats are many and alarming. Water security in terms of quantity and quality pose problems for both developed and developing countries. However, the consequences of future climatic change may be felt more severely in developing countries such as India, whose economy is largely dependent on agriculture and is already under stress due to current population increase and associated demands for energy, freshwater and food.

(v) Rise in Sea Levels

Nearly 70 % of Earth's surface comprises of water in the form of seas and oceans. Sea level rise under warming is inevitable. Sea level rise is both due to thermal expansion as well as melting of ice sheets. Thermal expansion would continue for many centuries even after GHG concentrations have stabilized causing an eventual sea level rise much larger than projected for the 21st century. If warming in excess of 1.9 to 4.6°C above pre-industrial level be sustained over many centuries then the final rise in sea level due to melting polar ice could be several meters, because it will be in addition to that of rise of sea level due to thermal expansion. The present scenario clearly indicates that the sea level will definitely rise.[38]

Satellite observations available since the early 1990s show that since 1993, sea level has been rising at a rate of around 3 mm per year, significantly higher than the average during the previous half-century.[39] IPCC predicts that sea levels could rise rapidly with accelerated ice sheet disintegration. Global temperature increases of 3–4°C could result in 330 million people being permanently or temporarily displaced through flooding. Warming seas will also fuel more intense tropical storms. With over 344 million people currently exposed to tropical cyclones, more intensive storms could have devastating consequences for a large group of countries. The 1 billion people currently living in urban slums on fragile hillsides or flood-prone river banks face acute vulnerabilities. People living in the Ganges Delta and lower Manhattan share the flood risks associated with rising sea levels.[40]

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[38] An Assessment of the Intergovernmental Panel on Climate Change: Climate Change 2007: Synthesis Report, p. 20

[39] IPCC Fourth Assessment Report, p. 111

[40] UNDP Human Development Report 2007-2008, p.78

(vi) Impacts on Coastal States in India

The coastal states of Maharashtra, Goa and Gujarat face a grave risk from the sea level rise, which could flood land (including agricultural land) and cause damage to coastal infrastructure and other property. Goa will be the worst hit, losing a large percentage of its total land area, including many of its famous beaches and tourist infrastructure. Mumbai's northern suburbs like Versova beach and other populated areas along tidal mud flats and creeks are also vulnerable to land loss and increased flooding due to sea level rise. Flooding will displace a large number of people from the coasts putting a greater pressure on the civic amenities and rapid urbanisation. Sea water percolation due to inundations can diminish freshwater supplies making water scarcer. The states along the coasts like Orissa will experience worse cyclones.

Many species living along the coastline are also threatened. The coral reefs that India has in its biosphere reserves are also saline sensitive and thus the rising sea level threatens their existence too, not only the coral reefs but the phytoplankton, the fish stocks and the human lives that are dependent on it are also in grave danger.

(vii) Ecosystems and Bio-diversity

Climate Change has the potential to cause immense biodiversity loss, affecting both individual species and their ecosystems that support economic growth and human well being. It is difficult to predict the overall result of climate changes on animal and plant kingdom.

Devastating effects on the native habitats of many animals and plants due to global warming is likely to drive a considerable number of today's known animal and plant species to extinction. Mass extinctions of the Earth's flora and fauna have occurred before also but those were driven by natural factors. However, the projected extinctions of flora and fauna in the future will be human driven *i.e.* due to adverse impact of human activities. The growth of human populations around the world, along with attendant pollution and loss of habitat, has set the stage for mass extinctions and large scale alterations in the flora and fauna.

According to International World Wildlife Fund (WWF) and National Wildlife Federation in the United States species from the tropics to the poles are at risk. Many species may be unable to move to new areas quickly enough to survive changes that rising temperatures will bring to their historic habitats. WWF asserted that one-fifth of the world's most vulnerable natural areas may be facing a "catastrophic" loss of species.[41] Another survey in 2004 of 5,743 amphibian species indicated that one in every three species was in danger of extinction due to global warming.[42]

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[41] Bruce E. Johansen, '*Global Warming in the 21st century: Plants and Animals in Peril*', p.536
[42] *Ibid*. p.579

Studies predict that global warming will also lead to extinction of insects in the tropical zone by the end of the century while insects in the temperate zones and the poles could experience a dramatic increase in numbers. It will also have catastrophic impact on the marine ecosystems. They will be affected not only by an increase in sea temperature and changes in ocean circulation, but also by ocean acidification, as the concentration of dissolved carbon dioxide (carbonic acid) rises. This is expected to negatively affect shell forming organisms, corals and their dependent ecosystems.[43] Accelerated warming of the atmosphere will also alter the flora and fauna around the world.

(viii) Impacts on India's Biodiversity

India is a land of mega-biodiversity, encompassing features from glaciers to deserts. However, climate change is posing grave threat to its ecosystems. Mountain ecosystems are hot spots of biodiversity. However, temperature increases and human activities are causing fragmentation and degradation of mountain biodiversity. ***The Himalayan Ecosystem*** is considered as the lifeline not only to India but also to our neighbouring countries such as China, Pakistan, Nepal, owing to the perennial rivers that arise out of the melting glaciers. It is home to the largest amount of glaciers after the North and the South Poles. However, climate change is threatening this life giver drastically.

It is also predicted that there will be an increase in the phenomenon of Glacial Lake Outburst Floods (GLOFs) in the eastern and the central Himalayas, causing catastrophic flooding downstream, with serious damage to 'life, property, forests, farms, and infrastructure'.[44] The melting glaciers of the Himalayas have a serious impact given the fact that they give rise to the perennial rivers that further flourishes the agriculture. The Himalayan rivers are closely interlinked with the ***Indo-Gangetic Ecosystem,*** which is primarily an agricultural ecosystem, nearly 65-70% of Indians having agriculture as their primary occupation.[45] The current scenario of food insecurity is also attributed to the climate change as human sustenance is greatly dependent on the agriculture of the Indo-Gangetic Ecosystem.

The National Environment Policy, 2006 states that the Indian ***Desert Ecosystems*** (arid and semi-arid region) occupies 127.3 mha (38.8%) of the country's geographical area and spreads over 10 states. The Indian desert fauna is extremely rich in species diversity of mammals and winter migratory birds. Recent studies have shown that deserts have shown signs of expansion, thus leading to a process called desertification. The climate patterns have altered the natural attributes of a desert region; for example the floods in the desert district of Barmer in Rajasthan in 2006. The recent conflicts of Darfur is also said to be linked to the climate change process, the tribe needs to expand due to the unavailability of pastoral land for their cattle which is their main occupation.

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[43] Biodiversity and Climate Change: Ecosystems (http://www.unep-wcmc.org/climate/impacts.aspx)

[44] ICIMOD Technical Paper: The Melting Himalayas, p.6

[45] India 2008

Coastal and Marine Ecosystem is one of the assets of India. The mangrove forests (wetlands) of the rivers and the coasts acts as carbon sink as well as a habitat for a unique and diverse species of plants and animals. The wetlands act as a natural barrier to flooding (that may be caused by the rising sea levels) and cyclones. The most explicit event in the perspective of climate change affecting the marine ecosystem is the example of coral bleaching.

In the Peninsular India, even the rivers of the Peninsula are dependent on the monsoons, thus the ***Peninsular Ecosystem*** is basically a monsoon dependent ecosystem. India is heavily dependent on the monsoon to meet its agricultural and water needs, and also for protecting and propagating its rich biodiversity. Climate change is linked with the changing patterns observed in the monsoons of India.

(ix) Climate Change and Health

Climate change poses a host of threats to the survival of mankind. The debilitating impact of climate change has broadened the sphere of discourse much beyond the traditional concern like environment or development. The far reaching consequences of climate change has forced policymakers and planners to look at every possible aspect of human survival. Arguably, it has catastrophic effects on human health. Each year, about 800,000 people die from causes attributable to air pollution, 1.8 million from diarrhoea resulting from lack of access to clean water supply, sanitation, and poor hygiene, 3.5 million from malnutrition and approximately 60,000 in natural disasters.[46] A warmer and more variable climate would result in higher levels of some air pollutants, increased transmission of diseases through unclean water and through contaminated food.

Climate change has a direct impact on human health. For example, the warmer the climate the likelihood of its impact on human health becomes worse. Available studies suggest that there will be an increase in health problems. It is anticipated that there will be an increase in the number of deaths due to greater frequency and severity of heat waves and other extreme weather events.

Climate change and the resulting higher global temperatures are causing increasing frequency of floods and droughts leading to the risk of disease infections. By 2090s climate change may bring a doubling in the frequency of extreme drought events. Many more million people are projected to be flooded every year due to sea-level rise by the 2080s.[47] Lack of freshwater during droughts and contamination of freshwater supplies during floods compromise hygiene, thus increasing rates of diarrhoeal disease. Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in hydrological cycle.[48] Flooding also creates opportunities for breeding of disease carrying insects such as mosquitoes. Areas affected

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[46] World Health Organization: Protecting Health from Climate Change

[47] Climate Change 2007: Impacts, Adaptation and Vulnerability (Working Group II Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Summary for Policymakers and Technical Summary)

[48] Climate Change 2007: Synthesis Report (A report of the IPCC, Geneva, 2007)

by frequent floods and drought conditions also witness large scale migration of populations to relatively stable regions leading to overcrowding and unhygienic conditions resulting in transmission of diseases like Japanese encephalitis and malaria.

Climate change is a major factor in the spread of infectious diseases. Diseases, confined to one specific geographic region spread to other areas. The World Health Organization (WHO) in their studies have indicated that due to rising temperatures, malaria cases are now being reported for the first time from countries like Nepal and Bhutan. It has also been predicted that an additional 220-400 million people could be exposed to malaria- a disease that claims around 1 million lives annually. Dengue fever is already in evidence at higher levels of elevation in Latin America and parts of East Asia. Climate change could further expand the reach of the disease.[49] Studies suggest that climate change may swell the population at risk of malaria in Africa by 90 million by 2030, and the global population at risk of dengue by 2 billion by 2080s.

Rising temperatures and changing patterns of rainfall are projected to decrease crop yields in many developing countries, stressing food supplies. This will ultimately translate into wider prevalence of malnutrition/ undernutrition. In some African countries, yields from rain-fed agriculture could be reduced by up to 50 per cent by 2020.[50]

Emission of the Green House Gases have been responsible for the depletion of ozone layer, which protects the Earth from the harmful direct rays of the sun. Depletion of stratospheric ozone results in higher exposure to the ultra violet rays of the sun, leading to an increase in the incidents of skin cancer. It could also lead to an increase in the number of people suffering from eye diseases such as cataract. It is also thought to cause suppression of the immune system.

The projections by WHO and IPCC[51] suggest that the negative effects of climate change on health are greater. In addition, the negative effects are concentrated on poor populations that already have compromised health prospects, thus widening the inequality gap between the most and the least privileged. The balance of positive and negative health impacts will vary from one location to another, and will alter over time as temperatures continue to rise.

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[49] UNDP Human Development Report 2007-2008

[50] Climate Change 2007: Impacts, Adaptation and Vulnerability (Working Group II Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Summary for Policymakers and Technical Summary)

[51] Climate Change 2007: Synthesis Report, IPCC, Geneva, 2007

IV

India's response to climate change challenges

The impact of Climate Change is so far-reaching that no country can now afford to sit on the sidelines. India, with 17 per cent of the world's population, contributes only 4 per cent of the total global greenhouse gas emissions against 30% approx. of the US and 25% of the EU countries. In terms of per capita GHG emissions, India is further lower at only 1.1 MT CO_2 (about 23% of the global average) as compared with the per capita emission of 22 MT CO_2 in US and 15 MT CO_2 in EU. The divergence in the status becomes starkly obvious when seen against the backdrop of the fact that around 55 per cent of India's population still does not have access to commercial energy.

It has been India's stand not to agree to any commitments related to reducing greenhouse gas emissions. India stands for equity in global negotiations on climate change. India believes that since developed countries are more responsible for the problem, owing to their historical as well as current emissions, they must deliver on their commitments to stabilize and reduce their emissions of GHGs.

In order to meet the demands of rising standards of living and providing access to commercial energy to those lacking it, the total emission of green house gases is bound to increase in India and also in other developing countries. India is committed to a path of sustainable development. Though India's per capita emissions are lowest in the world, we have recently adopted a National Action Plan on Climate Change. As a responsible nation, we are mindful of our obligations. Our efforts, of course, would be greatly enhanced with global support, especially in terms of financial flows and technology access.[52]

India has been pressing at the *UN Framework Convention on Climate Change* and other international conferences for collaborative development of clean technologies and immediate transfer of existing technologies which are environment friendly. India has also been trying to impress upon developed countries to transfer environmentally sound and cleaner energy technologies into the limited public domain for use by developing countries for early adoption, diffusion and deployment accompanied with transfer of financial resources. India had also called for early operationalization of the Adaptation Fund and Special Climate Change Fund under the United Nations Framwork Convention on Climate Change for addressing Climate Change issues in the developing countries.

India is a partner to the new *Asia Pacific Partnership on Clean Development and Climate* which consists of key developed and developing countries—Australia, China, Japan, South Korea and the USA besides India. It focuses on development, diffusion and transfer of clean and more efficient technologies and is consistent with the principles of the UNFCCC and complements the efforts under the UNFCCC and will not replace the Kyoto Protocol.

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[52] Speech of the Prime Minister of India, Dr. Manmohan Singh at G-8 Summit on Climate Change, July 9, 2008, Hokkaido, Japan

V

India's climate friendly measures

Despite the fact that India's contributions to greenhouse gas emissions are very small, the Government of India has taken many measures to improve the situation in this regard. The Ministry of Environment and Forests is the nodal agency for climate change issues in India. India has initiated several climate-friendly measures, particularly in the area of renewable energy. It has one of the most active renewable energy programmes besides having perhaps, the only dedicated Ministry for non-conventional energy sources in the world (Ministry of New and Renewable Energy).

India had adopted the National Environment Policy 2006 which provides for several measures and policy initiatives, to create awareness about climate change and help capacity building for taking adaptation measures. The National Forest Policy also envisages active measures for expanding carbon sinks through increase in forest and tree cover to 25 per cent by 2007 and 33 per cent by 2012. A major afforestation programme covering 6 mn hectares has been launched under the XIth Plan for this purpose.

On 30th June 2008 India unveiled its National Action Plan on Climate Change (NAPCC) with a view to lay down the priorities and future actions of the Government for addressing climate change and updating India's national programme relevant to addressing climate change. The National Action Plan identifies measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively. Eight national missions (solar mission, energy efficiency, sustainable habitat, water, Himalayan eco-system, green India, Eco-green agriculture and knowledge) have been specifically outlined to simultaneously advance India's development and climate change related objectives of adaptation and GHG mitigation. However, we have not set any quantitative goals towards emission reduction. Experts suggest to work out quantitative goals and specific institutional mechanisms and regulations in respect of all eight missions, besides evolving certain feasible and verifiable indicators for each mission for their impact assessment.[53]

Further, in pursuance to the announcement made by the Finance Minister while presenting the Union Budget 2007-08, the Government has set up an *"Expert Committee on Impacts of Climate Change"* on 7 May 2007 under the chairmanship of Dr. R. Chidambaram, Principal Scientific Advisor to the Government of India, to study the impacts of anthropogenic climate change on India and to identify the measures that India may have to take in the future in relation to addressing vulnerability to anthropogenic climate change impacts.

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[53] P.P. Sangal, India's Climate Change Action Plan, *The Economic Times*, New Delhi, 29 July, 2008

Moreover, a Council has also been set up under the Chairmanship of the Prime Minister of India on 6 June 2007 constituting eminent persons to evolve a coordinated response to issues relating to climate change at the National level and provide oversight for formulation of action plans in the area of assessment.

Besides, the Indian Government has initiated “Green India” programme which envisages undertaking massive afforestation of degraded forests land in the country. Financial resources to be mobilized include funds available under “Compensatory Afforestation Fund Management and Planning Authority (CAMPA)”, mobilising funds from the market, developing partner associations, and income from tree felling at ecologically appropriate intervals. The “Green India” programme will cover about six million hectare in the country in about 10 years.

VI

Alternatives

(i) Greater Share of Renewable Energy in the Energy Mix

To effectively address the concerns of climate change and to follow the path of sustainable development, the global energy diet, which is fossil fuels centric, must be changed. Efforts must be made to harness the potential of alternative sources of energy, such as hydropower, solar and wind and progressively make transition to clean energy. The science tells us that the climate stabilization requires humanity to cut its use of carbon fuels by at least 70 per cent.[54] Nature has endowed us with renewable energy resources abundantly.

We can also explore the possibility of harnessing nuclear energy for meeting the long-term energy needs. France, with 70 per cent of its energy use coming from nuclear source, has cut down its emissions, besides building a sustainable energy security for itself. We need to optimally use renewable energy resources and rewire the globe with clean energy. In the context of India, the change in energy diet is imperative, as at present, nearly 80 per cent of our energy comes from burning of fossil fuels, which is the greatest source of GHGs. We need to harness the solar energy and the wind energy and increase their share in our total energy mix. In this context, there is also a body of opinion that supports India's efforts towards increasing share in nuclear energy from the perspective of achieving long-term energy security and sustainable development.

India has maintained a consistent position that it will not make any commitments to reduce its GHG emissions since it has one of the lowest per capita emissions, and it is the developed world that created the problem in the first place and the developing world needs the carbon space to grow.[55] Yet, we need to take some firm measures in this direction as a responsible country. A close scrutiny of various sectors of the Indian economy would reveal that up-gradation of energy infrastructure, renewable energy infrastructure investments and policies that promote energy security present opportunities for GHG emission reduction.

Investment in renewable energy infrastructure is a priority area for action. Unless we make substantial investment in building and maintaining low carbon infrastructure in transportation, construction and other related sectors, we cannot meet the challenges of climate change in a long run. Our course of development should, therefore, be based on Clean Development Mechanism. Besides, R&D in alternative fuels and low carbon infrastructure must get due priority. Unless, we develop indigenous green technology, we cannot attain sustainable development.

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[54] IPCC: Second Assessment Synthesis of Scientific—Technical Information Report

[55] G. Ananthapadmanabhan, What should be India's stand at Bali climate meet? *The Economic Times*, 20 November, 2007

(ii) The Gandhian Approach Towards Sustainable Development

Mahatma Gandhi, an ardent champion of sustainable development, advocated harmonious existence of mankind with nature and ecology based on equity and justice. He said long ago in 1924, "Earth provides enough to satisfy every man's need, but not any man's greed".[56] With this world view, Mahatma Gandhi was engaged in criticizing the colonial modernity which went beyond the carrying capacity of the planet earth and exploited people and resources across the planet. Therefore, our freedom struggle under his leadership was in a way the first ever struggle in history for sustainable development.

Gandhiji's ideal life was an enlightened unselfish ethical life of plain living and high thinking. He wrote in 1938:

> "Man's happiness really lies in contentment. He who is discontented, however much he possesses, becomes a slave to his desires….. The incessant search for material comforts and their multiplication is an evil. I make bold to say that the Europeans will have to remodel their outlook, if they are not to perish under the weight of the comforts to which they are becoming slaves…".

Mahatma Gandhi was so peeved of the western culture and civilization that he wrote 'if India followed the western model of development she would require more than one planet to achieve the progress they had attained'.

The Nicolas Stern Committee Report on Global Warming and Global Economy also underlined the Gandhian philosophy when it observed that at the current rate of consumption of resources and energy of the planet, mankind would require more than one planet for survival. The Stern Committee Report, therefore, stressed on reduction of green house gas emissions by remodeling life style and by transiting from a carbon economy to a non-carbon economy.

We need to remodel our outlook and achieve the goal of sustainable development. By adopting a combination of factors which include the adoption of clean technologies, equitable distribution of resources and addressing the issues of equity and justice, we can make our developmental process more harmonious with nature.

[56] Collected Works of Mahatma Gandhi, vol. 29

VII

Summing Up

Climate change is the defining issue of our times. It is perhaps, the greatest challenge to sustainable development. It should be addressed by all countries with a shared perspective, free from narrow and myopic considerations. The developed countries need to look beyond their narrow self interests and work jointly with the developing countries to evolve cooperative and collaborative strategies on the issue of climate change, which is of immense relevance for the future of mankind. However, the efforts so far in the direction of meeting the challenges of climate change have been sporadic and incoherent. We urgently need a new economic paradigm, which is global, inclusive, cooperative, environmentally sensitive and above all scientific. According to Jeffrey Sachs, a perceptive commentator, "The world's current ecological, demographic and economic trajectory is unsustainable, meaning that if we continue with "business as usual" we will hit social and ecological crises with calamitous results". Sustainable development based on addressing the needs of the poor and optimal harnessing of scarce resources of water, air, energy, land, and biodiversity will have to be sustained through more cooperative endeavours. Then alone, we could make some headway in saving our lone planet from the brink of climate disasters.

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