CLIMATE CHANGE AND INDIA : IMPACT AND STRATEGY

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Abstract: We are challenged by a major threat –The Climate Change. It can be termed as a man- made disaster. Regular human interference has made our environment extremely sensitive. However, it has resulted in dwindling resources, high global warming and green- house gases emission. Nature has been exploited to such an extent that it is responding in a devastating manner. Nations are making keen efforts to arrest this gigantic problem. India is a special case in the study of nations trying to combat climate change. Widespread impact of Climate Change can be seen on health, agriculture, crops and forests among others. It is to be remembered that India is a developing Country. The main challenge is to strike a balance between the environment and development. This is a difficult task. This paper focusses on the threats of Climate change and India's effort to arrest it. The National Action Plan On Climate Change is India's strategic answer to the global menace. The eight national missions related to Solar, Water, Energy Efficiency ,Sustainable Habitat, Himalyan Ecosystem, Green India, Agriculture and Strategic Knowledge are aimed at the reduction of the impact of Climate Change.

Keywords: Action Plan ,Climate Change ,Development, Green- house gases.

Introduction:"History indicates that we do not accept large scale changes easily, especially when this change challenges our accepted beliefs. It generally takes a crisis to overcome our resistance. The challenge of sustainability, particularly climate change, has characteristics that make our normal resistance to change both deeper and longer lasting. It is an enormous system wide challenge that affects every person and every country. It also questions many fundamental beliefs about growth and the market economy and threatens some very powerful interests. So when the crisis is big enough to force a change, it will also have great and unstoppable momentum. As a result it will be far more damaging, because the impacts will continue to worsen long after we act on the causes."[1]

It is not easy to overlook this gigantic problem of climate change. The scenario becomes worse for developing countries like India which are very vulnerable to its impacts. These countries are already battling with problems of over-population and the resultant problems of poverty, unemployment and many more. In addition to all these, is the crisis related to climate change. Developed countries are incessantly pressurizing India and China to take major mitigation measures to arrest climate change. Hence India faces a typical situation, threatened from multiple ends, be it natural, political or economic. Therefore this paper is an attempt to understand the huge impact of Climate Change on crucial sectors in India and its action plan to combat it.

India: India is the world's second most populated nation. Carbon dioxide emissions in the year 2008 from total fossil fuels emissions, rose from 8.1% over the 2007 levels to 475 million metric tons of carbon. Since 1994 fossil fuel consumption has doubled in India. Being the second largest populated nation, the per capita emission rate for 2008 of 0.40 m. tons of carbon is below the global average of 1.30 m. tons. This is attributed to low standard of living and high levels of poverty for many citizens.[2]

India is the largest population Centre in southern Asia and the region is vulnerable to future effects of climate change. According to Inter- Governmental Panel on Climate Change (IPCC) this region can experience a temperature increase on the order of five degrees centigrade by 2080. (IPCC Third Assessment Report Working Group II 2001). This could result in serious impact on agriculture, forest resources and coastal resources, serious health related stress and vector borne diseases such as malaria as well as changes in water availability are some of the bad effects of climate change which India might suffer from.

Here it becomes essential to understand the impact of climate change on the crucial sectors.

Impact Of Climate Change:

1. **Impact of climate change on Agriculture:** India's location makes it economically dependent on agriculture. A likely impact of climate change on agriculture productivity in India is causing great concern to Indian scientists and planners. The potential effect of climate change on agriculture in India would be the shift in the sowing time and length of growing season which would ultimately alter planting and harvesting dates of crops and varieties currently used in a particular area. With warmer temperatures, evapotranspiration rates would raise, which would call for much greater efficiency of water use. Increased temperature is likely to reduce the wheat production particularly in north India. Morey and Sadaphal (1981) reported a decrease of wheat yield by 400 kgha-1 for a unit increase of 1°C.

Saseendran et al (2000) showed that for one degree rise in temperature, the decline in rise yield would be about 6%. Major impacts would be on rain fed crops (other than rice and wheat), which account for nearly 60% of cropland area which will greatly affect poorest farmers who mainly depend on rain fed agriculture.[3]

2. **Impact of climate change on Crop Productivity:**Increase in atmospheric carbon dioxide has a fertilization effect on crops with C3 photosynthetic pathways and thus, promotes their growth and productivity. On the other hand, an increase in temperature, can reduce crop duration, increase crop respiration, and alter photosynthetic partitioning to economic products, effect the survival and distributions of pest populations thus developing new equilibrium between crops and pests and increase evapotranspiration. Altogether, there can be a tremendous impact on agricultural production and food security of any region.

In eastern and northern regions, the beneficial effect of 450, 550 and 650 ppm CO_2 was nullified by an increase of 1.2-1.7, 3.2-3.5 and 4.8-5.0°C, respectively. In southern regions, positive CO_2 effects were nullified at temperatures lower than these. Thus southern and western parts of India with lower temperatures as of now are likely to show a less increase in rice yield under climate change.

Mundal and Kaur (1996) examined the climate change impact on productivity of wheat, rice, and maize and groundnut crop in Punjab. If all other climate variables were to remain constant, temperature increase of 1,2 and 3°C from present day condition, would reduce the grain yield of wheat by 8.1, 18.7 and 25.1%, rice by 5.4, 7.9 and 25.1%, maize by 10.4, 14.6 and 21.4% and seed yield in groundnut by 8.7, 23.2 and 36.2% respectively.[4]

3. **Impact of climate change on Health:**It has been well documented that climate change in occurring and will affect human health in various ways, from weather related mortality to disasters, water-borne diseases, air pollution, malnutrition and vector borne diseases. Although various diseases, respiratory, are the result of climate change also, here we are going to discuss the impact of climate change on vector borne diseases. India is affiliated with six major vector borne diseases namely, malaria, dengue, chikanguniya, filariasis, Japanese encephalitis and leishmaniasis. Among these malaria ranks number one. In sum, vector borne diseases results in both mortality and morbidity which results in great economic losses.

Table 1. LOAD OF VECTOR BORNE DISEASES IN INDIA IN 2010

DISEASES	CASES/ANNUM	DEATHS
Malaria	**1.59 million**	**1023**
Filariasis	**600"**	**NA**
Kala Azar	**28,941**	**105**
Dengue	**28,299**	**110**
Chikanguniya	**56.355 (6695 tested 1431 confirmed)"**	**NA**

Source adapted from www.nvbdcp.gov.in

As temperature, rainfalls keep changing, so also mosquitoes' vectors variation can be seen. Climate change has brought large changes in temperature and rainfall patterns. This has also brought changes in diseases in India. Density of mosquito vectors, daily survival and feeding rate affects entomological inoculation rate due to changes in environmental temperature (Lindsay and Birley 1996; Martens 1998a; Martens, Kovats, Nijhof, et al 1999). Increase in thresholds of temperature results in increase/decrease in malaria.

As climate change has brought changes in rainfalls, so excessive rainfall can facilitate breeding grounds for mosquitoes or flushing off the existing breeding while dry conditions can either eliminate or create several new breeding habitats in large water bodies such as lake and rivers.

Similarly in 'Dengue' climatic conditions play a very important role in the transmission of dengue in addition to water storage practices and life-styles. The role of temperature, rainfall and relative humidity (RH) in the biology of Aedes mosquitoes and the epidemiology of dengue has been well established. So also, Leishmaniasis is a climate sensitive disease affecting development of sand fly vectors. Hence it is clear that climatic change will surely affect the health of India and the variations in temperature and rainfall will add up to the already bad states of vector borne diseases.[5]

4. Impact of climate change on Forests in India: India is a mega diversity where forests account for

about 20% (64 million ha) of the geographical area with nearly 200,000 villages classified as forest villages there is large dependence of communities on forest resources. Climate change is going to affect not only this dependence on forests but also the entire biodiversity. The climate impact assessment made for Indian forest sector using regional climate model (HadRM3) outputs and BIOME4 vegetation model has shown that nearly 68 to 77% of the forested grids are likely to experience change, which includes loss of area under a given forest type as well as replacement by another type from the prevailing forest type by 2085. In other words over half of the vegetation is likely to find itself less optimally adapted to its existing location, making it vulnerable to adverse climatic conditions as well as to biotic stresses. Further the actual negative impact may be more than what is initially expected from the above description. This is because different species respond differently to the changes in climate. Thus, one expects that a few species may show a steep decline in populations and perhaps even local extinctions. This, in turn, will affect the other taxa dependent on the different species (the 'domino' effect) because of the interdependent nature of the many plant animal-microbe communities that are known to exist in forest ecosystems. This could eventually lead to major changes in the biodiversity.[6]

Thus, climate change could cause irreversible damage to unique forest ecosystems and biodiversity, rendering several species extinct, locally and globally. Forest ecosystems require the longest response time to adapt, say through migration and regrowth.

Thus we see that India is very vulnerable to climate change. This vulnerability is not limited only for the present times but in times to come as well. As the crisis of climate change worsens, India is going to face more problems. This can be proved by a report prepared by Indian network for Climate Change Assessment (INCCA).

Impact of climate change on India in the 2030s:

The report prepared by INCCA assess the impact of climate change in 2030s. As former environment minister Mr. Jairam Ramesh has said that no country in the world is as vulnerable, on so many dimensions, to climate change as India. Therefore the impact of climate change will also be massive.

1.a) Impact of climate change on temperature:

It is indicated that an overall all round warming over the Indian subcontinent will take place in the 2030s. The annual mean surface air temperature is projected to rise by 1.7°C to 2.0°C as in the 2030s. Seasons may be warmer by around 2.0°C towards 2030's.

b) Extreme temperature:

Analyses indicate that both the daily extremes in surface air temperature, that is daily maximum and daily minimum may intensify in the 2030s.

2. a) Impact of climate change on precipitation:

Analyses show a small increase in annual precipitation in the 2030s with respect to the baseline, that is 1970s.

b) Extreme precipitation:

It can be defined in terms of number of rainy days if it exceeds the currently observed average number of rainy days in a year (exceeding 2.5 mm) as well as the volume of rain fall in a day if it exceeds particular threshold. Projections for 2030s indicate that the frequency of the rainy days is likely to decrease in most parts of the country.

3. Impact of climate change on cyclones:

Since 1986, a decreasing frequency in cyclones along the eastern coast surrounded by the Bay of Bengal and the Northern Indian Ocean has been observed. The projected number of cyclonic disturbances along both the coasts in the 2030s is estimated to decrease with respect to the 1970s. However, cyclonic systems might be more intense in the future.

4. Impact of climate change on storm surges:

Storm surge return periods could only be estimated on a 100-year time scale. It is found that all locations along the eastern coast of India, that are north of Vishakhapatnam, except Sagar and Kolkata, show an increase in 100-year return periods of storm surges by 15% to 20% with respect to the 1970s. With the two stations considered in the head Bay, namely Sagar and Kolkata, increase in 100 year return periods for the future scenario were found to be less than 5%.

In the above study we find that climate change will have profound impact on agriculture, health, productivity and forests. Not only this, the 2030s will be witnessing tremendous changes in temperature, cyclones, storms and precipitation. These studies are enough to prove that the present as well as future of India is going to be very challenging in terms of impact of climate change.[7] However, India cannot stop its progress due to the fear of the dangers associated with Climate Change because, development for India is a necessity not a post materialist luxury like the developed world.it has to develop or perish the basic necessities of its huge population have to be fulfilled. Thus India has to develop at any cost. India has to strike the appropriate balance between development and environment.

Development And Environment: India is continuously moving on the path of development. However, the concept of development has taken various contours. Today, the world and as its part, India realizes that merely following development model is not sufficient. It has to fulfill the requirement of sustainable development, a form of development which takes into account its ultimate dependence on the natural environment (Pezzey 1989). The term sustainable development covers

three concerns for human welfare- economic, social and environmental- as well as the inter dependencies and inter linkages between them. The question which, arises is that whether India is able to develop itself in sustainable manner. In order to understand this, the present challenge of India is the challenge of progressing in a sustainable manner.

India is unique among the developing countries because it has a vast population to support, big reserve of natural resources and rich forests and biodiversity. Despite the natural endowments, its biggest challenge is to utilize them in an optimal manner.

The National Population Policy 2000 warns India's current annual increase in population of 15.5 million is large enough to neutralize efforts to conserve the resource endowment and environment as per the Department of Family Welfare (DOFW 2000). It might appear pessimist, yet it is true that growing population continues to place huge pressure on our resources. Therefore population is already challenging the development scenario.

India is also facing the problem of alleviating poverty, though the percentage of population below the national poverty line has fallen from 36% in 1993/94 to 28% in 2004/05 (GOI 2008). The rate of decline in poverty is not in line with the growth in GDP, and what is even more striking is that the incidence of poverty among certain marginalized groups, such as SC/ST has hardly declined.

As far as literacy rate is concerned, India lags behind several Asian countries. The literacy rate has gone up from 18.3% in 1951 to 64.8% in 2001, yet the number of illiterate persons is very high exceeding 304 million. (GOI 2008)

This shows though there has been improvement in the various facets of human development in India, the country has still a long way to go. It has to maintain a fine balance between development and environment. At present, this balance seems to be disturbed.

Economic progress: After the liberalization process, India recorded one of the fastest recoveries from a macroeconomic and balance of payments crisis. The services sector in India has been witnessing an enormous growth. Within this sector, the IT and ITES have emerged as a source of great strength to the country generating income and facilitating growth. India accounts for 65% of the global market in offshore IT and 46% of the ITES.

The achievements of the economic sector have to be matched with those of the social sector and environment as well.

Environment at the altar of development?

In its pursuit of growth, India has also witnessed widespread environmental damage and degradation. While growing at a fast pace, with an average annual growth rate of about 6% in the post liberalization period, the country has failed to internalize in the development process the costs of environmental degradation. The country has paid an enormous price for this onward march. Results from different studies show that the economic costs of degradation in India have ranged between 3.5% and 7.5% of the country's GDP. These can be summarized in the table below:-

Annual Cost Of Depletion And Degradation (% of GDP)			
	PARIKH KAND PARIKH J (1994-1997)	TERI (1997)	GAISP(a)
AIR	0.4	5.81b	0.03-0.48c
WATER	1.7-2.1	0.80	3.43
LAND/SOIL	0.3-0.8	0.58	1.50
FORESTS	1.1-1.6	0.37	0.00
TOTAL	3.5-4.9	7.57	4.96-5.41

a) Analysis is for the following years: air, 2000-01; water and forests, 2002/03, land and soils, 2001/02. Almost the entire cost of water pollution is on account of surface water pollution, since data was not readily available for groundwater. These figures represent the share in the net domestic product.

b) Based on low emission scenario including indoor air pollution.

c) Based on Sengupta and Mandal (2005) GAISP-Green Accounting for Indian States and Union territories Project.

These estimates suggest that a major departure need to be made from India's past pattern of development.

The development has to be sustainable and at the same time, one which promotes a future that is socially equitable and ecologically sustainable.

Therefore it is extremely crucial that India, as one of the fastest growing economies of the world along with China, does not lose sight of its environmental objectives and maintains and establishes synergy between health, environment, energy and the development process.[8]

I."ENVIRONMENTAL POLICY IN INDIA"

The approach followed by the Ministry of Environment and Forest (MOEF) in India during the 1980s and 1990s for ensuring environmental sustainability relied heavily on the involvement of the government agencies (e.g. inspections) for checking water, air pollution and land degradation as well as protection of wildlife and forests. Private participation was strictly regulated as well as limited. For e.g. the National Environmental Awareness Campaign (NEAC) was launched in July 1986 but the problem of deforestation, air and water pollution remained a major concern during this period.

The industrial sector remained comparatively unconcerned about the environmental hazards in pursuit of economic growth. This was the scenario throughout 1980s. This led to an increase in the number of public interest litigations lodged by different environmental advocacy forums since the late 1990s (Rajmani 2007). The involvement of judiciary significantly contributed to enhance environmental quality. (Sahu 2007; Sawhney 2003; Prasad 2004). However, Faure and Raja (2010) note that legislature and Executive still provide the best reduction in the light of informational advantage enjoyed by them.

Since late 1990s, the need for ensuring greater public private partnership for environmental management in India started receiving greater emphasis. The government launched the National Environment Policy (2006) through a thorough discussion with experts as well as a comprehensive dialogue with different stakeholders. This can be considered culmination of the public private involvement in environmental policy making.

The National Environment Policy (NEP) 2006 aimed at enhancing this public private partnership. It strongly advocated that people dependent on particular natural resources obtain better livelihoods from the conservation initiatives. The steps involved in the NEP for integrating a particular section of the population in environment management are as follows:-

a) Participation of local communities is required for securing better wildlife conservation, expansion of protected areas. Public agencies and other stakeholders also matter.
b) Conservation and use of wetlands need active participation of all relevant stakeholders including local communities, for better maintenance and conservation of biodiversity.
c) The government is expected to undertake extensive consultations every three years with groups of diverse stakeholders (e.g. researchers, experts, voluntary organizations etc.) and on the basis of the consultations; the NEP needs to be regularly updated.[9]

i. The National Action Plan on Climate Change (NAPCC)

1. **Overview:** Like any other country India is also facing the challenge of sustaining its economic growth alongside dealing with climate change. The threat is more dangerous because the GHG concentration in the atmosphere is constantly rising on account of industrial growth and high consumption lifestyles.

Thus India has chalked down a national action plan to reduce the growing intensity of GHG concentration in the atmosphere. Not only this, India is also serious about the need to reduce this concentration because India's development path is closely tied to its natural resources base and climate sensitive sectors such as agriculture, water, and forestry.

In preparing a developmental pathway which is ecologically sustainable India has a number of alternatives available because it is at an early stage of development. Thus India envisions a prosperous but not a wasteful society, an economy that is self-sustaining in terms of its ability to unleash the creative energies of its people, at the same time mindful of its responsibilities to both present and future generations.

India has also decided to join hands with the international community in controlling climate change. India is a signatory of the UNFCCC and its objectives is to establish an effective, cooperative and global approach based on the principle of common but differentiated responsibilities and respective capabilities, enshrined in the UNFCCC.

India also ensures to render desired help in mitigating climate change provided the developed countries affirm their responsibility for accumulated greenhouse gas emissions and fulfill their commitments under the UNFCCC, to transfer new and additional financial and climate friendly technologies to support both adaptation and mitigation in developing countries.

India is determined that it's per capita emission, will at no point, exceed that of the developed countries even as it pursues its developmental goals.

2. **Principles:**India is committed to follow a development path that simultaneously advances

economic and environmental objectives, the National Action Plan on Climate Change (NAPCC) will be guided by the following principles-

- Protecting the poor and vulnerable sections of society through an inclusive strategy sensitive to climate change.
- Achievement of national growth objectives through a change in direction that enhances ecological sustainability while reducing GHGs.
- To engineer new and innovative forms of market, regulatory and voluntary mechanisms to promote sustainable development.
- To implement programs through unique linkages as required, with civil society, local governments and through public private partnerships.
- Deploying techniques for both adaptation and mitigation of greenhouse gases emissions extensively as well as at an accelerated pace.
- Welcoming international cooperation for research, development, sharing and transfer of technologies enabled by additional funding technology transfer to developing countries under UNFCCC.

3. The Way Forward:

3.1 Eight National Missions: The eight National Missions which form the core of the National Action Plan represent multi-pronged, integrated and long term strategies for achieving key goals in the context of climate change. Many of these programs are already part of the current actions; they may need a change in direction, enhancement of scope and effectiveness. The eight National Missions are as follows:-

i. National Solar Mission (NSM)
ii. National Water Mission (NWM)
iii. National Mission for Enhanced Energy Efficiency (NMEEE)
iv. National Mission for Sustainable Habitat
v. National Mission for Sustaining the Himalayan Ecosystem
vi. National Mission for a "Green India"
vii. National Mission for Sustainable Agriculture
viii. National Mission on Strategic Knowledge for Climate change[10]

I. National Solar Mission

This mission has been implemented by Ministry of New and Renewable Energy (MNRE), Govt. of India. The mission will adopt a three phase approach: Phase I (2010-2013), Phase 2 (2013-17), and Phase 3 (2017-22).

1. Targets:

To achieve this, the Mission targets are:

- To create an enabling policy framework for the deployment of 20,000 MW(scaled up to 100,000) of solar power by 2022.
- To ramp up capacity of grid-connected solar power generation to 1000 MW within three years, in the second phase, another 3000 MW to 9000 MW would be added depending upon international finance and technology transfer. The ambitious target of 20,000 MW or more, for 2022 will be dependent on the 'learning' of the first two phases.
- To achieve 15 million sq. meters solar thermal collector area by 2017 and 20 million by 2022.
- To deploy 20 million solar lighting systems for rural areas by 2022.

2. Strategy:

a) Utility connected applications

The key driver for promoting solar power would be through a Renewable Purchase Obligation (RPO) mandated for power utilities, with a specific solar component. This will drive utility scale power generation, whether solar PV or solar thermal.

b) The off grid opportunity- lighting homes of the power- deprived poor:

A key opportunity for solar power lies in decentralized and off-grid applications. In remote areas, where grid penetration is neither feasible nor cost effective. Thus solar energy applications will prove cost-effective.

The mission plans to: Provide solar lighting systems under the ongoing remote village electrification program of MNRE to cover about 10,000 villages and hamlets.[11]

II. National Water Mission:

Objectives: The Mission aims at conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water management.

Major Identified goals:

1) Comprehensive water data base in public domain and assessment of impact of climate change on water resources.

2) Focused attention to vulnerable areas including overexploited areas.

Strategies:

Goal- I

Comprehensive water data base in public domain and assessment of impact of climate change on water resources.

i. Review and establishment of network for collection of additional necessary data [2010-11].
ii. Developing inventory of wetland [2011-12].
iii. Research and studies on all aspects related to impact of climate change on water resources including quality aspect of water resources with collaboration of all research organizations working in the area of climate

change [continuing activity, to be expanded during XI and XII Plan].

iv. Re-assessment of basin wise water situation [2010-11].

Goal- II

i. Promotion of storages benefitting drought prone areas and rain deficient areas.[continuing activity, to be expanded during XI and XII Plan]

ii. Promotion of traditional system of water conservation –expeditious implementation of program for repair, renovation and restoration of water bodies [continuing activity, to be expanded during XI and XII Plan][12]

III. National Mission for Enhanced Energy Efficiency (NMEEE)

The Ministry of Power (MOP) and Bureau of Energy Efficiency (BEE) were asked to prepare the implementation plan for the National Mission on Enhanced Energy Efficiency (NMEEE).

1) Four new initiatives were undertaken by the MOP and BEE in addition to the already existing program on energy efficiency. They are:-

a. Perform Achieve and Trade
A market based mechanism to increase cost effectiveness of improvements in energy efficiency in energy intensive large industries and facilities, through certification of energy savings that could be traded (Perform, Achieve and Trade)

b. Market transformation for Energy Efficiency (MTEE):
Increasing the shift to energy efficient appliances in respective sectors through innovative measures to make the products more affordable.

c. Energy Efficiency Financing Platform (EEFP):
Creation of mechanisms that would keep finance demand side management programs in all sectors by capturing future energy savings.

d. Framework for Energy Efficient Economic Development (FEEED):
Developing fiscal instruments to promote energy efficiency.[13]

IV. National Mission on Sustainable Habitat

This Mission has three components.

A. Promoting energy efficiency in the residential and commercial sector.

B. Management of municipal solid waste.

C. Promotion of urban public transport.

A. **Promoting energy efficiency in the residential and commercial sector:**The residential sector in India accounts for nearly 13.3% of total commercial energy use in India..

Electricity consumption in the residential sector is primarily for lighting, space conditioning, refrigeration and other appliances. Thus energy saving measures related with space conditioning (heating and cooling), refrigeration, and lighting have a great importance in moving towards sustainable energy use.

The commercial sector comprises of banks, hotels, offices and public buildings. In a typical commercial building in India, around 60% of the total electricity is consumed for lighting, 32% for space conditioning and 8% for refrigeration.

It is estimated that the implementation of energy efficient options would help in achieving around 30% electricity saving in new residential buildings and 40% electricity savings in new commercial buildings. In case of existing buildings, the energy saving potential for residential buildings is around 20% and that for commercial building is around 30%

Research and Development: The main focus is to develop energy efficient technologies. Energy efficient products for the following applications are required:-

- Energy efficient buildings & building component.
- Low cost insulation material.
- Development of simulation software to predict the energy used in buildings.
- Energy efficient appliances.
- Very low energy consuming circuits for standby power.
- Development of low cost light emitting diodes (LED) based lamps for space lighting.
- Policy and Regulatory Steps
- The Energy Conservation Building Code (ECBC) was developed after the adoption of Energy Conservation Act (2001). The ECBC aims to support adoption of energy savings and savings of GHG emissions by reducing the baseline energy consumption. The ECBC guidelines show that 50% energy savings can take place in buildings made with ECBC in comparison to conventional constructions.
- However the problem is that Large-scale availability of appropriate materials and equipment is urgently required. There are just a handful of manufacturers of such products which monopolize the market. Thus it is required that demands for such products should be increased so that competition among players producing such products not only produce in quantities but it also result in reducing the cost of such products.

- The Ministry of Environment and Forests (MOEF) has developed a manual for clearance of large scale construction projects.

B. **Management of Municipal Solid Waste (MSW):** Recycling of materials is an important option for reducing environmental pressures. In comparison to other developed countries India has a high rate of recycling of materials in MSW.

Policies and Regulations

The 74th Constitutional Amendment (1992) transferred the responsibility for collection, treatment and disposal of MSW from State Governments to the Urban Local Bodies (ULBs). There is laxity on the part of urban local bodies as far as disposal of MSW is concerned. There is open dumping of waste. The dominant technology choice remains composting.

It is generally estimated that MSW operations are not profitable. Hence it is required that MSW operations should be considered as public good (environmental service) requiring net fiscal expenditures by the concerned local bodies. Other suggestions are as follows:

- Integrated Systems for collection, transport, transfer, treatment and disposal facilities, as opposed to open dumping.
- Common Regional Facilities: Disposal facilities for smaller towns and villages should be developed as a common regional facility.
- Implementation of MSW operations through public-private partnerships. Municipal finances are required to be sound before the outsourcing of MSW functions is done. The issue of municipal finance is a serious one. There is urgent need of separation of the accounts of local bodies in respect of their different responsibilities, such as MSW, sewage disposal, water supply and roads.

C. Promotion of Urban Public Transport

The growing population and economic growth has led to the increase in the demand for transportation sector. The total number of registered motor vehicles in India has increased from 21.4 million in 1991 to 72.7 million in 2004. Road based transportation is the main source of GHG emissions in the transportation sector.

The Energy and Research Institute (TERI) estimates an energy saving of 144 Million Tons of Oil Equivalent (MTOE) in2031by including efficiency improvement across modes as well as considering enhanced use of public transportation and rail based movement, use of bio-diesel as compared to business-as-usual trends. The corresponding CO_2 emissions reduction is estimated at 433 million tons in 2031.

Actions for the transport sector are as follows:

Promoting the use of coastal shipping and inland waterways, apart from encouraging the attractiveness of rail-based movement relative to long-distance road based movement.

- Encouraging energy R&D in the Indian Railways.
- Introducing appropriate transport pricing measures to influence purchase and use of vehicles in respect of fuel efficiency and fuel choice.
- Stringent fuel economy standards for automobile manufacturers.
- Setting up of a demonstration unit to take up recycling of vehicles, especially two wheelers, which require new techniques.
- Setting up a Combustion Research Institute to facilitate R&D in advanced engine design.[14]

V. National Mission for Sustaining the Himalayan Ecosystem

The Himalayan ecosystem is vital to the ecological security of the Indian landmass. Climate change has adversely affected this Himalayan ecosystem. Concerns have also been raised that the Himalayan glaciers, in common with other entities may lose significant ice mass. This is supposed to affect the Indian River system, especially in the lean season, when the North Indian Rivers are largely fed by melting snow and ice.

Thus various steps are planned for saving this important ecosystem-

- Continuous and enhanced monitoring of the Himalayan ecosystem, in particular the state of its glaciers and the impacts of glacial mass of river flows.
- Exchange of information and appropriate forms of scientific collaboration may be considered with them to enhance understanding of ecosystem changes and their effects.
- Empowerment of local communities, in particular through the Panchayat, to assume greater responsibility for management of ecological resources.

  The National Environment Policy, 2006, provides for the following relevant measures for conservation of mountain ecosystems:
- Adopt best practice norms for infrastructure construction in mountain regions to avoid or minimize damage to sensitive ecosystems and despoiling of landscapes.
- Encourage cultivation of traditional varieties of crops and horticulture by promotion of organic farming enabling farmers to realize a price premium.
- In order to promote sustainable development of mountain ecosystem, appropriate land use planning and watershed management practices to be adopted.

- Promotion of sustainable tourism through adoption of "best practice" norms for tourism facilities and access to ecological resources. At the same time multi stakeholder partnerships to be encouraged so that local communities gain better livelihoods, while leveraging financial, technical, and managerial capacities of investors.
- The tourist inflows into mountain regions to ensure that these remain within the bearing capacity of the mountain system.
- Development of unique mountain areas as entities of "Incomparable Values" and develop strategies for their protection.

VI. National Mission for a Green India

Forests are of a great importance. In India, they meet nearly 40% of the energy needs of the country and over 80% of those in rural areas. They are the backbone of forest-based communities in terms of livelihood and sustenance. They also sequester billions of tons of carbon dioxide in the form of biomass and soil carbon.

The mission aims at-

A. Increasing forest cover and density as a whole of the country.

B. Conserving biodiversity.

A. Increasing forest cover and Density: It is planned that the forest cover should be 1/3 of the total geographical area. The greening India program plans to afforest 6 million hectares of degraded forest land with the participation of Joint Forest Management Committees (JFMCs). An additional 600 crores have also been provided for the program. The elements of this Program may include the following:

- Training on silvicultural practices for fast-growing and climate- hardy tree species.
- Promoting public private investments for raising plantations.
- Upgrading community based initiatives such as Joint Forest Management (JFM) and Van Panchayat committees for forest management.
- Formulation of forest fire management strategies.

B. Conserving Biodiversity: Specific actions programs in this regard are as follows:

- In-situ and ex-situ conservation of genetic resources, especially of threatened flora and fauna.
- Effective implementation of the Protected Area System under the Wildlife Conservation Act
- Creation of biodiversity registers (at national, regional, and local levels) for documenting genetic diversity
- Strong implementation of the National Biodiversity Conservation Act, 2001.

VII. National Mission for Sustainable Agriculture

In India agriculture is of utmost importance. It Contributes 21% to the country's GDP, 11 % of total exports, employs 56.4% of the total workforce, and supports 600 million people directly or indirectly. Agriculture is vital to India's economy and the livelihood of its people.

The mission has aimed at four core areas namely dry land agriculture, risk management, access to information, and use of biotechnology.

A. **Dry land agriculture:**Out of the net cultivated area of approximately 141 million hectares, about 85 million hectares (60%) falls under the dry land rain-fed zone. Accordingly, there is an urgent need to prevent declines in agricultural yields during climatic stress. For this various efforts will be made:

- Development of drought- and pest-resistant crop varieties
- Improving methods to conserve soil and water
- Financial support to enable farmers to invest in and adopt relevant technologies to overcome climate related stresses
- Stakeholder consultations, training for farmers for agro-climatic information sharing.

VIII. National Mission on Strategic Knowledge for Climate Change

The key points of this mission:

- Research in important domains of climate science including monsoon dynamics, aerosol science and ecosystem responses.
- Global and regional climate modeling to improve the quality of climate change over the Indian sub-continent, including changes in hydrological cycles.
- Creation of essential research infrastructure, such as high performance computing and very large bandwidth networks to enable scientists to access and share computational and data resources.

A. **Climate Modeling and Access to Data:**In India spatially detailed assessments are not available. This is because of inadequate computing power available, difficulties in getting climate related data, and dearth of trained human resources amongst climate modeling research groups in India. The following actions are proposed:

Enhanced Research on climate modeling in India: There is a need to develop high resolution Air Ocean General Circulation Models (AOGCM) and nested Regional Climate Models (RCM) that simulate regional climate change, in particular monsoon behavior, by pooling institutional capabilities and computational resources.

In respect of General Circulation Models (GCM), there is a need to build national level core climate modeling groups to develop high resolution coupled AOGCM that effectively simulate monsoon behavior. These would be employed for multi-ensemble and multi-year simulations of the present and future climate. Indigenous Regional Climate Models are necessary to generate accurate future climate projections up to (at least) district level. Regional data re-analysis projects should be encouraged. A Regional Model Inter comparison project (RMIP) for climate is required to minimize uncertainty in future climate projections.

B. **Promoting Data access:**There are several databases that are relevant for climate research, along with the respective agencies that are responsible for collecting and supplying that data. It is planned that each of these Ministries and Departments may appoint a 'facilitator', who will provide access to the data. A concept of 'registered users' has been also proposed who can have access to scientific data held by the various Ministries of the Government.

C. Strengthening Networks: The creation of an integrated National Knowledge Network (scalable and ultimately of 10 Gbps capacity) as suggested by the National Knowledge Commission and the Principal Scientific Adviser's Office would obviously benefit climate modelers. The upcoming Grid Computing stands out as a unique technology for handling terabytes of experimental data requiring hundreds of teraflops of computing power.[15]

Thus we see that India has also been working on reduction of GHG emissions under its active action program. However, like any other action plan, India's NAPCC is not perfect. It also has its own weaknesses as well as strengths. An analysis of the same has been presented in the following pages.

ii. Critical Analysis of India's National Action Plan on Climate Change (NAPCC)

In this report a detailed assessment of the NAPCC has been given. Some very crucial aspects of the NAPCC have been touched through interviews of the experts in field of climate change. The methodology therefore can be described as a modified Delphi method.

I. Key observations and tensions that run through the policy: The experts, who were interviewed, were of the opinion that the pressure and challenges in developing NAPCC have resulted in certain tensions that run through the missions. The study concentrated mainly on the design of the mission, not so much on implementation. The reason being implementation analysis is too early to be considered as many missions are not yet concretely implemented.

1. Broad goals or focused on specific elements?

The broad question is that will the missions encompass a wider arena or will they be focusing on specific elements? Water, agriculture, green India are big missions. In a sense that they deal with so many aspects, cover many administrative levels. These are issues which have been problematic in the past also. Such problems cannot be expected to be solved through a climate mission. On the other hand, the Himalayan and Strategic Knowledge missions are broad (cross-sectoral) while responding to singular goals. Thus the striking argument against the missions is that it would have been better if smaller aims would have been aimed at rather than big missions.

2. International or domestic aspirations?

This question varies from one mission to another. For example, the National Solar Mission is a relatively new area and one where it appears that the country would like to make a mark internationally and demonstrate its commitment to addressing climate change.

On the other hand, the missions for sustainable agriculture concentrate on fulfilling national ambitions in agriculture.

3. Some missions concentrate on principles, some on strategies and specific modalities.

Green India Mission is an example where principles are given importance to. On the other hand, the Mission on Enhanced Energy efficiency is a case of strategies and modalities.

4. The current or the future?

India is on the path of development. Hence it is following some development actions. At the same time there are climate policies that are trying to mould development according to the specific guidelines. The question which arises is that how can one differentiate between climate policies and development actions that have a climate benefit? The policies recommended will lead to avoided emissions but there are no emissions targets set by any missions. Generally, therefore there is no mention of the level of mitigation or abatement expected in describing the climate action plans.

5. Missing the co benefit?

The overall climate policy emphasizes sustainable development with a reduction in greenhouse gas emissions, or mitigation as a co-benefit. But experts' point of criticism is that sustainable development goals and targets have not been clearly specified or prioritized in all cases. Some examples of this lacuna are as follows:

- The Solar Mission does not consider off grid solar as its focal point. This could have provided lighting for those that have poor connectivity or no grid connection.
- The Sustainable Agriculture Mission does not make low-chemical practices its leitmotif, which would be needed for sustainable

development and at the same time reduce greenhouse gases among other benefits.

6. A Routined Planning Document Not a Mission or Action Plan

Various predictable problems have arisen because of the structural unevenness in the NAPCC. In large domain areas, little or no attempt has been made to take on seriously some of the embedded challenges, for example, removing environmentally destructive subsidies for chemical fertilizers. As a result, the mission document is no different from the usual planning document with a few points on climate thrown in between. Experts suggest it is business-as-usual mindset and suggested that narrower and clearer priorities and strategies would have helped in such cases.

7. Lack of integration among the missions

These mission have been placed in eight separate compartments has itself led to viewing the problems and solutions with sector specific lenses. This has raised concerns about the ability of different missions and even different divisions within some ministries to implement the policies. Another result of this perspective is that there is little synergy among the missions, which are still being viewed in terms of portfolios of ministries operating in different domains. The NAPCC outlines the need for working across missions in various places but there is no indication as to how this would actually take place. The multi dimensionality of climate impacts makes it vital that India adopts a completely new approach that is interdisciplinary in its nature, breaks traditional ministerial boundaries. Unless India is able to do so, our goals for 'climate-proof' development will not be attained.

8. Lack of Big Vision

Climate change is such a gigantic problem that it requires long-term planning that would go over many Five Year Plans. One good starting point might have been a long-term big picture from which medium-term goals and plans and then missions could have been derived. The current process and the design of the missions do not suggest any big vision, a big picture or any long-term planning. One persistent question regarding the missions was: Where will all the land come from for expanding agriculture, Green India and Habitat?[16]

Recent efforts towards combating climate change by India: On his January visit to India, President Barack Obama along with ShriNarendraModi reiterated the importance of clean energy, research and development. President Obama agreed for funding India's target of 100 GW of solar energy by 2022.

At the December 2014 meeting of the Conference of Parties at Lima, Peru the Minister for Environment, MrPrakashJavadekar made important announcements regarding the efforts of India to arrest climate change.

Some of them were –

1. Doubling the clean energy cess on coal – It is a major initiative on the part of India as this cess is levied by few countries in the world
2. The scaling up of National Solar Mission from 20,000 MW to 100,000 MW. This means an additional investment of 100 billion dollars and savings of about 165 million tones CO_2 emissions per year
3. The project of making 100 smart cities with integrated policies for adaptation and mitigation towards climate change.
4. Action plan for river Ganga.

However it was made clear by the Minister for Environment that India is a developing country which is responsible towards a large population of poor people. Hence it is required that the basic amenities of such people should be fulfilled on a priority basis. Therefore keeping in mind the different circumstances of India, developed countries should respect the principle of equity and common but differentiated responsibilities. Developed countries should shoulder the responsibility of providing finance and technology to India.[17]

Conclusion: Thus we see that India is making efforts to face the giant-The climate Change. The most important concern is that India is a part of a globalized world. The recklessness of one country can result in the misery of another. No one can forget the statement made by President Bush in !992 that the American lifestyle was not for negotiation. The world knows that the American consumerist lifestyle has prevented populations across countries to lead a decent lifestyle. The tendency of over-consumption of natural resources of developed countries have resulted in the dearth of resources for poor countries. India is no exception. It is made to suffer on account of the excessive use of natural resources by the developed world.

India is also caught in a vortex. It is heavily indebted and desperately require investment capital in order to activate the economy .Although the present government has started the "Make In India" campaign, yet developed countries are apprehensive about the success of the same. The efficacy of the same is questionable because large scale foreign investment result in the over exploitation of the depleting natural resources. India like any other developing country is facing a situation similar to the "Social Dilemma" in game theory,in which individual and collective rationality are at odds with each other. In this theory players attach more weight to their

short term interests rather than long term benefits from co-operative solution. They end up harming everyone including themselves.[18] India and China are looked upon as the decisive players of the game of Climate change. The safest move can be sustainable use of the available resources so as to make it available for the present population as well as for the future generations. India has to take revolutionary actions. The world is watching.

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