The Coast isn't clear

Climate Change & India's Coastal Communities:
Regional Notes on Climate Change and What we must do about it.

Indian Network on Ethics and Climate Change (INECC).
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for
Indian Network on Ethics and Climate Change
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Climate Change and India's coastal communities
Bio-regional notes on climate change

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MUMBAI MIRROR

WHILE THIS COULD HAPPEN TO OUR CITY AGAIN...

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THAT IS TO BLAME

Preface

Climate change in coastal regions has taken a turn for the worse. It consequences go beyond damage to the coast. Environmental disasters in the form of displacement of human settlements due to drastic temperature change and increase in sea-levels are plaguing our world.

Climate change is linked with the cosmic cycle, the solar cycles, ice ages and so on. However when we speak of global warming, we are more concerned with anthropogenic (originating from human) activity. It is mainly a by-product of the path of development taken by a privileged section of society. Unfortunately, those who make the decision, whether they are from the political leadership or the corporate, or from the media and the bureaucracy of consultants and experts, still do not ask the correct questions or seek to look at the real issues confronting the world today.

This is particularly clear in the context of coastal regions, where most of the discourse centres around the physical aspects namely, sea level rise, changes in ocean currents and global weather patterns. Melting icebergs and glaciers, the ozone hole etc are often discussed more as distant phenomena that pose a threat to nations across the world, rather than a more proximate problem associated with the growth model of development. Also, it is assumed that with technological advances and massive investment projects (like sea walls), the solution will be found. This is far from the truth.

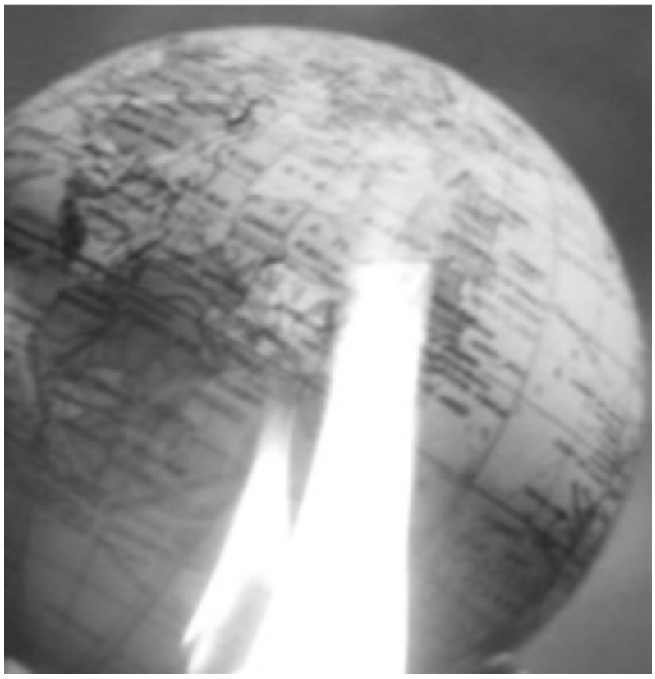
The IPCC (Inter-Governmental Panel on Climate Change) report released in February 2007 notes that sea levels are rising faster than previous forecasts. In fact, sea levels, which rose on average 1.8mm a year between 1961 and 2003, doubled between 1993 and 2003 - rising by 3.1mm per year.

As we take a look closer at the coastal regions, one realizes that it is the marginalised populations that are directly affected by sea-level rise, storm surges, environmental damage and diminishing marine bio-resources. It is then that the ethical implications of the choices of the paths of development (and consequent climate change) become clear. This also raises ethical questions for those who are at the doorstep of the same paths of development. Is there another door?

I
About Climate Change

"Ignoring climate change will be the most costly of all possible choices, for us and our children"
–Peter Ewing

What is Climate Change? What is Global Warming



Climate Change refers to variation in global and regional climates over time. It is about changes in the climate system as a whole and changes and shift in the average pattern and intensity of climate phenomenon. It does not refer to day to day changes in the weather.

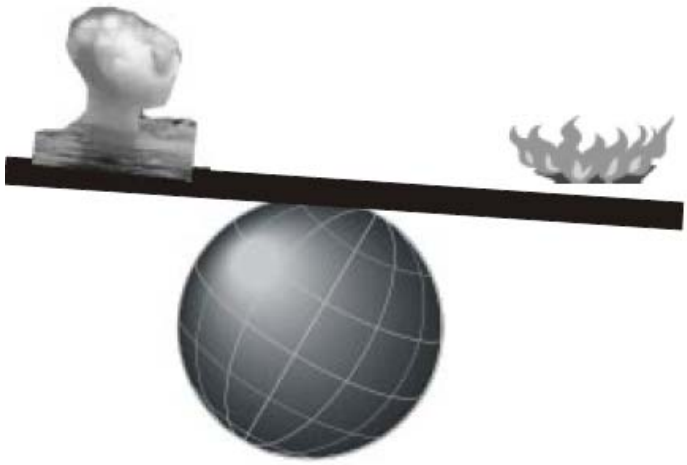
The Sun and the intensity of its light and heat is the most important driver of climate and therefore changes like sun-spot activity do influence climate changes.

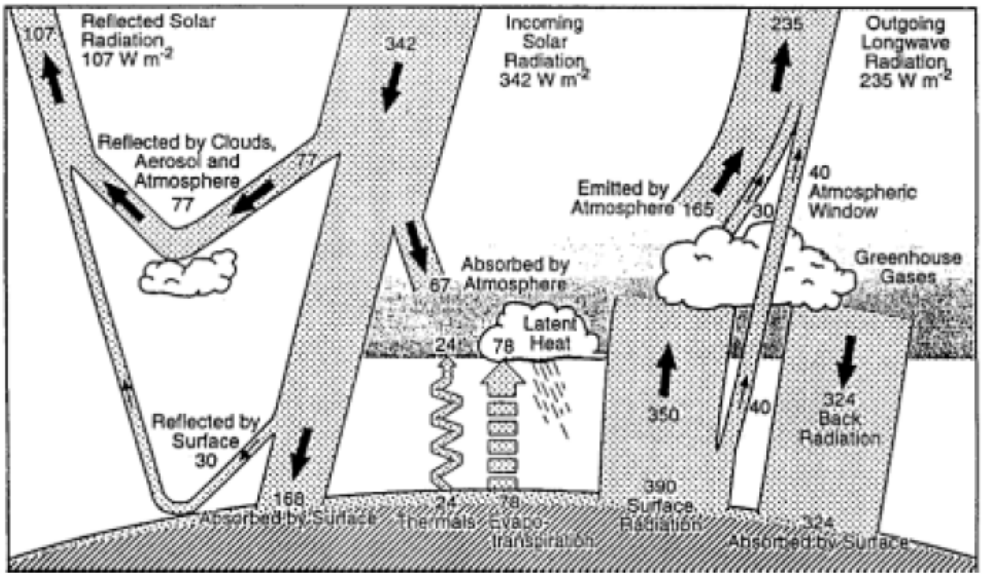
These days however whenever we talk about climate change, we are referring to one type of climate change namely Global Warming. Global Warming refers to a long term increase in the average temperatures, which is also global in nature. It refers to the disturbance in the balance between heat and cold in the earth's atmosphere, caused by the increase in Green House Gases(GHGs) in the atmosphere. This disturbance in the balance is largely due to human activities.

According to the Fourth Assessment Report of the IPCC, the average global temperatures are likely to increase further by 1 to 6.4ºC by 2100. The adverse effects of this change are already being seen, and they are only likely to worsen. Thus, there is tremendous concern about it.

Balancing Act

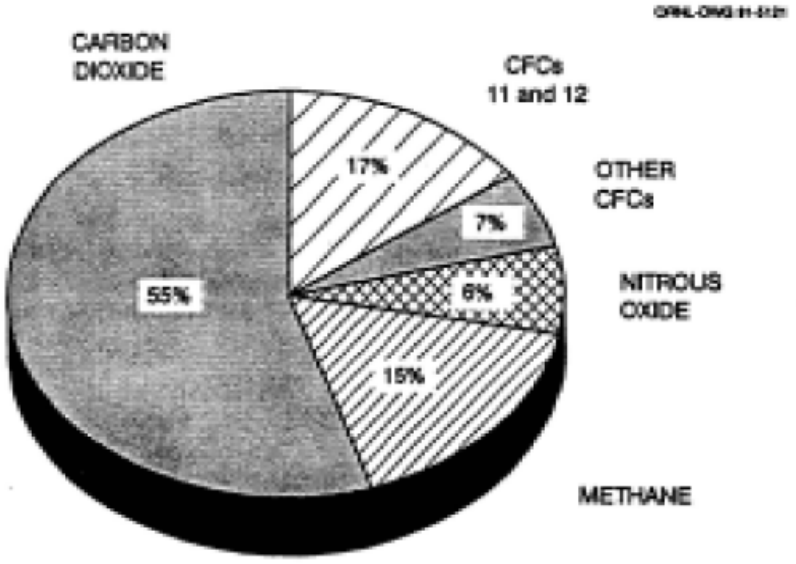
On Earth, two elements, Nitrogen (N_2) and Oxygen (O_2), make up almost 99% of the volume of clean, dry air. The inert gaseous element Argon accounts for most of the remaining 1%. Argon and the tiny percentage of remaining gases are referred to as trace gases.





A detailed sketch of the radiation budget of the Earth-ocean atmosphere system (from Kiehl and Trenberth, 1993)

Some of these gases present in the atmosphere (CO_2, CH_4, N_2O etc) contribute to the warming of our planet. They are referred to as Greenhouse Gases (GHG). These gases allow the short-wave energy to reach the Earth's surface unimpeded. At the same time longer-wave (heat radiating) energy is reradiated to the atmosphere. The green house gases can absorb the longwave energy, thus acting as a kind of blanket around the earth: they trap heat and keep the planet around 30°C warmer than it would be otherwise. The right thickness of atmosphere along with the right mix of these gases keeps the atmosphere temperature at pleasant levels making life possible on Earth.



Relative contributions of greenhouse gases to change in relative forcing from 1980 to 1990 (Source IPCC "Climate Change", 1990)

Impacts of Climate Change

Global climate change has different effects on different regions of the Earth. Jeffrey Sachs of the Earth Institute warns that four types of geographies will share the largest burden of climate change crisis: low-lying coastal settlements, farm regions dependent on river water from glacier and snow melt, sub-humid and arid regions that suffer from drought, and regions of Southeast Asia facing changes in monsoon patterns.

In India a large part of agriculture is rainfed with a large population dependent on it for their livelihood. Thus making them completely vulnerable to Climate Change.

a) Extreme weather

Midday, 24 Sep 2005

Most of the potentially damaging consequences relating to climate change are being associated with extremes - for example the number of heat waves, floods, or severe storms.

The climatological record of the past several decades offers evidence that likely consequences of a warmer atmosphere are greater numbers of heat waves and fewer periods of extreme cold.

As a result of global warming; oceans have become warmer, and humidity and water vapor have increased 4% since 1970 because warm air holds more vapor than cold air. This has increased tropical storm activity.

As the planet gets warmer, more evaporation could take place leading to heavy rain and increase in frequency and intensity of floods.

The increase in GHG in the atmosphere will impact the natural hydrological cycle. If increased temperatures cause an intensification of the water cycle, there will be more extreme variations in weather events, as droughts will become prolonged and floods will increase in force. It has been projected that latitudinal variation is likely to affect the distribution of water resources.

This could have a catastrophic impact at several places especially in countries such as Bangladesh where more than 17 million people live at an elevation of less than 3 ft. above sea level, and millions more inhabit the flat banks of the Ganges and Brahmaputra Rivers.

However evaporation and precipitation occur at different places, and if the planet warms, while wet regions could receive even more rainfall, evaporation may be accelerated in drier regions and they could face acute water shortages. This, in turn, will accelerate desertification and give rise to acute water supply shortages.

b) Shrinking water resources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NIRMAL SANDHU

GRASSROOTS, 01 DEC 2006

Water quality degradation will be a major cause of water scarcity. Where these is increase in precipitation, the rain flushes the higher levels of nutrients, pathogens and pollutants - which were originally stored in the groundwater reserves - out in the discharged water. In areas of decreased precipitation and runoff, there is a concentration of effluent in the water, which leads to an increased microbial load in waterways and drinking-water reservoirs. Additionally, the rise in water temperature can adversely affect different inhabitants of the ecosystem due to a species' sensitivity to temperature.

Warming accelerates the rate of land surface drying, leaving less water moving in near-surface layers of soil. Less soil moisture leads to reduced downward movement of water and so, less replenishment of groundwater supplies.

Water availability is likely to be further exacerbated by poor distributional management, where elevated water tables suffer from overuse from increasing population, and an increase in water demand for agricultural production, and industrial production.

Areas in mid latitudes and mountainous regions depend upon glacial runoff to replenish river systems and groundwater supplies. These areas will become increasingly susceptible to water shortages with time, because increased temperatures will initially result in a rapid rise in glacial melt water during the summer months that will be followed by a decrease in melt as the size of the glacier continues to shrink. This reduction in glacial runoff water is projected to affect approximately 1/6 of the world's population (IPCC).

Sea-level rise will not only extend areas of salinity, but will also decrease freshwater availability in coastal areas.

c) Rise in sea-level

Many islands are gradually facing the loss of their fresh water supply due to salt-water intrusion. At least 300 million people live in low-lying coastal areas and deltas and they are particularly threatened by sea level rise. It could accelerate coastal erosion and force the relocation of communities and infrastructures.

The average sea level rose by 10 to 20 cm during the 20th century, and an additional increase of 18 to 59 cm is expected by the year 2100. Higher temperatures can cause the ocean volume to expand and glaciers to melt thereby causing the water to overflow onto the heavily populated coastlines of countries like Bangladesh and drown islands like Maldives.

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d) Ecosystem

Ecosystem services are fundamental life-support services provide by the ecosystem. Human civilization depends directly or indirectly on the products and services provided by ecosystems. These include crops, livestock, fish, wood, clean water, oxygen, wildlife, pollination, erosion prevention, nutrient cycles, climate moderation and detoxification of natural substances.

Climate change has the potential to alter ecosystems and the many resources and services they provide to each other and to society. It could benefit certain plant or insect species by increasing their ranges. The resulting impacts on ecosystems and humans, however, could be positive or negative depending on whether these species were invasive (e.g. weeds or mosquitoes) or if they were valuable to humans (e.g. food crops or pollinating insects).

Most of the world's endangered species (some 25 per cent of mammals and 12 per cent of birds) may become extinct over the next few decades.

e) Health

Climate change can have both direct and indirect human health impacts. WHO has estimated that the increase of temperature by 1^{0} F in the quarter of the 20^{th} century, was responsible for the annual loss of about 160,000 lives and the loss of 5.5 million years of healthy life by 2000. The toll is expected to double to about 300,000 lives and 11 million years of healthy life by 2020.

The exacerbated air pollution levels, and heat waves directly contribute to deaths from cardiovascular and respiratory diseases, especially among the elderly people.

Vector-borne diseases such as Schistosomiasis, Chagas disease, Sleeping sickness, River blindness, and various strains of encephalitis all could change their ranges and patterns of infection in the course of climate change.

The increase of Chlorofluorocarbons in the atmosphere, leading to global warming will increase UV radiation in the atmosphere, affecting the immune systems and leading to infectious diseases.

Indirect impacts arise from changes in temperature patterns, which may disturb natural ecosystems and cause large-scale reorganization of plant and animal communities. Probably the impact of climate change on water availability is likely to be one of the most significant for the health of populations.

Rising temperatures, changing patterns of rainfall, and more frequent droughts and floods are projected to decrease crop yields in many developing countries causing shortages of food supplies. This could result in severe malnutrition, especially among children, in countries where large populations depend on rain-fed farming at subsistence level.

f) Agriculture and food security

Temperature-induced range changes may push populations into new areas for which they are otherwise poorly adapted. It may render local cultures, economies, and infrastructure (that had been uniquely shaped around specific food resources), obsolete. The range, migration habits, and life cycles of pollinators and plants, pests and their prey, and wild food-stocks and their predators, will all be affected.

In general agricultural producers will face less stress from extreme cold events and freezes but higher stress from more frequent and more intense heat waves. Such events can damage crops, kill or stress livestock, and disrupt or destroy both natural resources and necessary infrastructure. Parasites, diseases, fungi and other pests will thrive and spread faster in warmer and more humid climates. Due to sea level rise, agricultural areas, such as low-lying river deltas and brackish estuaries will be increasingly susceptible to saltwater intrusion. The oceans are absorbing excess amounts of carbon dioxide making the environment acidic which is unsuitable for sea life.

Higher concentrations of atmospheric carbon dioxide allow plants to grow faster and larger. Farmers may have to use more herbicides. Due to CO_2, sometimes plants may speed through the growth phase in which they generate their harvestable grains, fruits or vegetable matter. As a result the harvest may be diminished and less nutritious.

g) Shelter

Human-induced climate change threatens to create an unmanageable environmental refugee crisis during this century. Most in danger are people in the developing world who have the least ability to adapt to climatic variability. Many scholars and activists working on this issue are pushing for international legal recognition of environmental refugees.

The Indian Situation

Climate change is likely to impact all the natural ecosystems as well as socio-economic systems as shown by the National Communications Report of India to the UNFCCC(www.natcomindia.org/natcomreport.htm).

The latest high resolution climate change scenarios and projections for India, based on Regional Climate Modeling (RCM) system, known as PRECIS developed by Hadley Center and applied for India using IPCC scenarios A2 and B2 (see box below) shows the following:

- An annual mean surface temperature rise by the end of century, ranging from 3 to 5°C under A2 scenario and 2.5 to 4°C under B2 scenario, with warming more pronounced in the northern parts of India.
- A 20% rise in all India summer monsoon rainfall and further rise in rainfall is projected over all states except Punjab, Rajasthan and Tamil Nadu, which show a slight decrease.
- Extremes in maximum and minimum temperatures are also expected to increase and similarly extreme precipitation also shows substantial increases, particularly over the West Coast of India and west central India.

Exact quantitative predictions of impacts is difficult. Therefore scientists work on computer models which take into account different scenarios. The PRECIS system develops calculations for the following different scenarios :

A1 model: Very rapid economic growth, a peak in global population by the mid-21st century, rapid development of more efficient technology, with conversions between developed and developing regions. The A1 scenario is further subdivided into fossil-intensive (A1F1), non-fossil energy sources (A1T) or a balance across sources (A1B).

A2 model: A very heterogeneous world, with preservation of local identities. Economic development is locally focused, resulting in slower development but continuous population increases.

B1 model: A convergent world economy, similar to scenario A1, though with a heavy focus on clean and resources-efficient technologies, with an emphasis on global solutions to economic, social and environmental sustainability.

B2 model: Again a heterogeneous world similar to A2 though with an emphasis on local solutions to economic development social and environmental sustainability.

Some of the projected Impacts of climate change in India: (scidev.net)

Water resources: The hydrological cycle is likely to be altered and the severity of droughts and intensity of floods in various parts of India is likely to increase. Further, a general reduction in the quantity of available run-off is predicted.

Agriculture: Simulations using dynamic crop models indicate a decrease in yield of crops as temperature increases in different parts of India. However, this is offset by an increase in CO_2 at moderate rise in temperature and at higher warming, negative impact on crop productivity is projected due to reduced crop duration.

Forests: Climate impact assessments using BIOME-3 model and climate projections for the year 2085 show 77% and 68% of the forested grids in India are likely to experience shift in forest types under A2 and B2 scenario, respectively.

Indications show a shift towards wetter forest types in the northeastern region and drier forest types in the northwestern region in the absence of human influence. Increasing atmospheric CO_2 concentration and climate warming could also result in a doubling of net primary productivity under the A2 scenario and nearly 70% increase under the B2 scenario.

Coastal zone: Simulation models show an increase in frequencies of tropical cyclones in the Bay of Bengal; particularly intense events are projected during the post-monsoon period. Sea level rise is projected to displace populations in coastal zones, increase flooding in low-lying coastal areas, loss of crop yields from inundation and salinization.

Human health: Malaria is likely to persist in many states and new regions may become malaria-prone and the duration of the malaria transmission windows is likely to widen in northern and western states and shorten in southern states.

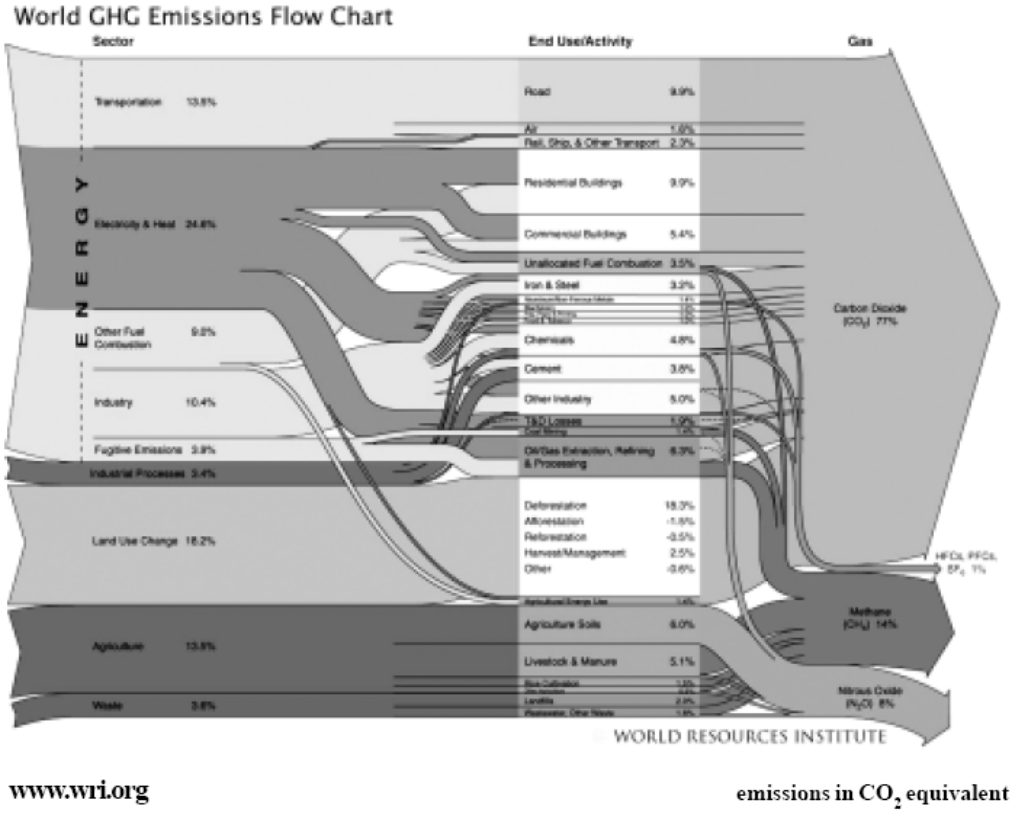
Causes of Climate change

Human activity - particularly the burning of fossil fuels - has made the blanket of greenhouse gases around the earth "thicker." Forest destruction, bad agricultural practices and other gases in the atmosphere also play a role. This has caused the problem of global warming to rapidly worsen.

The sheer volume of carbon dioxide in the atmosphere compared to other trace gases means that carbon dioxide is by far the largest contributor to anthropogenic greenhouse warming. Over the past two centuries the concentration of carbon dioxide in our atmosphere has increased about 30 percent, from a pre-industrial level of about 270 parts per million to a current level of 384 parts per million. If the consumption of fossil fuels such as coal and oil continues into the next century at projected rates, the carbon dioxide concentrations in the atmosphere would reach the 600-700 parts per million by 2100.

The following chart of GHG emissions, indicates the relative contribution of different sectors and sub-sectors to GHG emissions in the year 2000. It also correlates each sub-sector to the end use activity on the right side and the gases it emits.

The sector contributing the maximum emissions is the energy sector, with transportation contributing 13.5 percent, of which transportation of food itself is about 9.9%.



Another large sub-sector is Electricity & Heat (24.6 %) which alongwith other fuel combustion is 33.6%. Of this, residential building contribute to 9.9 %, and commercial buildings 5.4% and industries 22.4%.
Deforestation is the next biggest culprit - 18.3 %.

Agriculture contributes 15%. And the bulk of it is methane emission 9% and nitrous oxide a little over six percent.

A reading of this chart, therefore provides a clue as to which sectors are critical contributors to global warming all of which seem to be related to the growth model of development that humans have chosen. It begs the question, what are our priorities? And within these priorities what alternatives are there to reduce emissions.

De-forestation-Reforestation is one obvious area. The second, a more political one - a food system where you consume only locally produced food, reducing food miles.

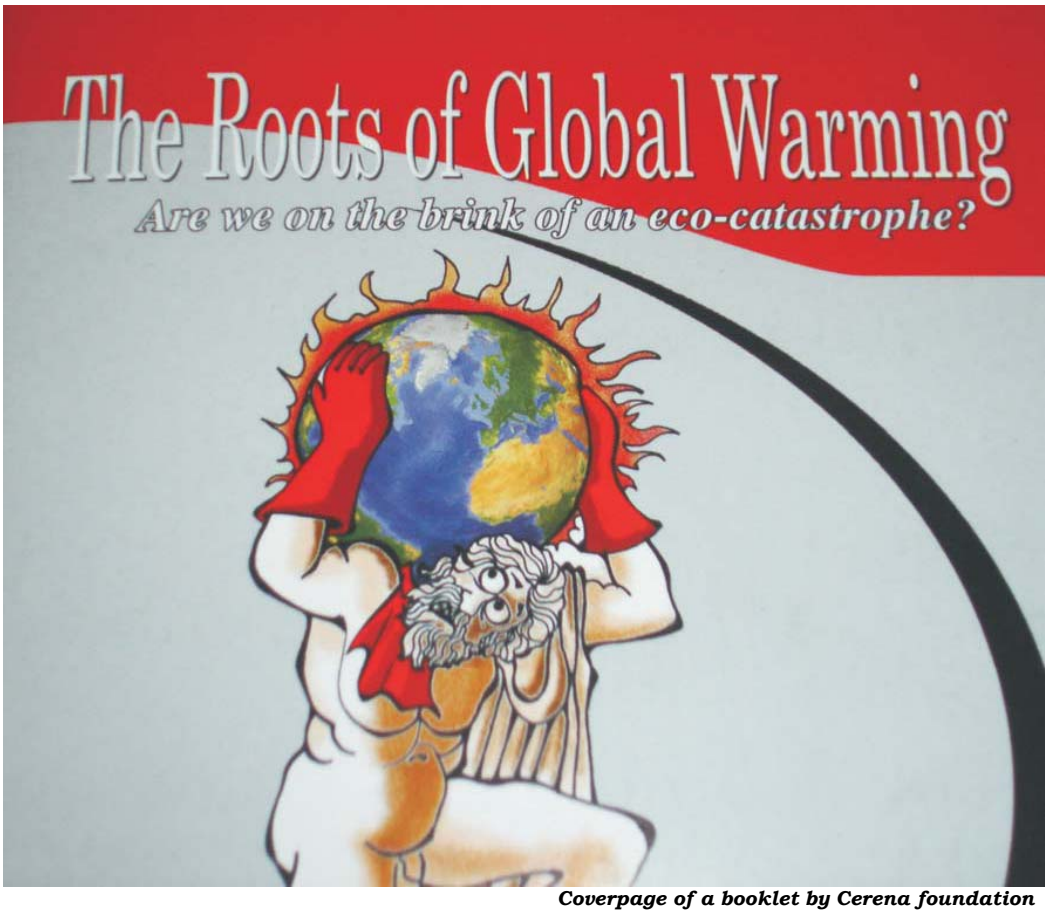
Alternative renewable fuels at least for those uses that can be managed by low density energy delivery, and more efficient lighting, air-conditioning.

Alternative low fossil fuel based technology for Cement, Iron and Steel, Chemicals, are also the major source of possible reduction.

Agriculture too can contribute in a big way. Capturing of methane emissions for energy, reduction of fertilizers and pesticides through organic farming would also contribute substantially to emmission.

And last but not least would be recycling wastes, and redesigning land fills.

The question being asked is what is the world doing about it? Essentially if seems that all countries are looking at it from their own economic viewpoint, either to protect their dirty businesses, or to trump up new solutions under which they could make some money.



Coverpage of a booklet by Cerena foundation

II

Climate Change and world politics

"All our efforts to defeat poverty and pursue sustainable development will be in vain if environmental degradation and natural resource depletion continue unabated"
-Kofi Annan

Climate Change International Negotiations

1988: Toronto Conference:
Agreed at 20% cut in GHGs from 1988 levels by 2005.
Intergovernmental Panel on Climate Change (IPCC) set up by UNEP and World Metereological Organization to give report every five years.
Climate Action Network formed in US. A Bangladeshi Atiq Rehman took the lead. CAN-South Asia formed where CSE, DA, TERI played a prominent role.

1989: First IPCC Assessment Report: Co-relationship between carbon in air and ice caps.

1992: Rio conference of UNCED (earth summit)
United Nations Framework Convention on Climate Change to stabilise Green House gas concentrations in the atmosphere at a level that it would prevent dangerous anthropogenic(from human activity)interference with the climate system.
Precautionary Principle agreed at.
The framework was ratified in 1993 and Annual Conference of Parties was established.

1994: 1st COP, Berlin
Agreed that firm and tougher reductions were needed
Berlin mandate

1996: Second IPCC Assessment Report
Acknowledge that human influence on Climate Change "likely".

1997: 3rd COP, Kyoto
KYOTO PROTOCOL: identified what is needed to reduce GHGs,
Reduce global emissions by 5.2% of 1992 levels by 2008/12, Show improvement by 2005.
Annexure 1 countries must achieve 8% reduction.

2000: 5th COP, Hague
Mechanism for action necessary, No agreement reached between US & EU on mechanisms.

2001: 6th COP, Bonn
Agreed on Mechanisms for action
Carbon sinks
International Carbon trading
Technology Transfer to less developed countries.

2002: 7th COP, Marrakesh
Agreed to terms of implementation
Agreed to consultation on Technology Transfer.

2006: 12th COP, Nairobi
Nairobi Framework: Six UN agencies to help developing countries, esp Africa, participate in CDMs.
First discussions on post- KYOTO (after 2012).

2007: 4th IPCC Assessment Report
Warming of the climate system is unequivocal.

2009: 13th COP -Bali
Bali Plan to work towards a new agreement in COP 15 in Copenhagen 2009
Call for "measurable, reportable, and verifiable" and nationally appropriate mitigation efforts by developed countries and "measurable, reportable, and verifiable" mitigation efforts by developing countries as well!

More people are using more resources with more intensity than at any point in human history. Population growth, globalization, rising consumption and affluence, pollution and waste and persistent poverty are putting increasing pressure on the environment. A huge "consumption gap" exists between industrialized and developing countries. The world's richest countries, with 20 per cent of global population, account for 86 per cent of total private consumption, whereas the poorest 20 per cent account for just 1.3 per cent. A child born today in an industrialized country will add more to consumption and pollution over his or her lifetime than 30 to 50 children born in developing countries (UNFPA).

Industrialized countries have been the largest producers of greenhouse gases that are the cause of climate change. In developing countries nearly 60 per cent of the 4.4 billion people lack basic sanitation. Almost a third do not have access to clean water, one quarter lack adequate housing, 20 per cent do not have access to modern health services and 20 per cent of children do not attend school through grade five. Poverty is causing many poor people to increase their pressure on fragile natural resources to survive. Limited land availability often leads poor people to settle in fragile areas (UNFPA).

Increasing urbanization presents another challenge. Many cities in developing countries face serious environmental health challenges and worsening conditions due to rapid growth, lack of proper infrastructure to meet growing needs, contaminated water and air, and more garbage than they can handle. The livelihoods and economic activities of people in developing countries are very closely tied to the natural resource base and are highly sensitive to changes in the climate. In addition the adaptive capacities are limited due to poverty.

Global Response to Climate Change

Way back in the 60s and 70s, Climatologists and Environmentalist had evidence of increase in concentrations of carbon dioxide in the atmosphere. However it took years before the international community responded to their call for action.

In 1988, the World Meteorological Organization and the United Nations Environment Programme (UNEP) created an Intergovernmental Panel on Climate Change (IPCC). Its reports are now widely used by policymakers, experts and students. IPCC's first assessment report in 1990 spurred governments to create the United Nations Framework Convention on Climate Change (UNFCCC) at the Rio Earth Summit of UNCED in June 1992. The treaty was aimed at stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

Next Major stop - KYOTO

Since the Earth Summit, a Conference of Parties to the Convention (COP), has been meeting every year. It was at the 3rd COP in Kyoto, that a protocol was actually worked out to establish legally binding commitments for the reduction of greenhouse gases produced by industrialised countries (who were named in Annex 1 in the protocol) as well as general commitments to tackle global warming from all member countries.

By January 2009, 183 countries and one regional economic integration organization (the EEC) have deposited instruments of ratification, accession, approval or acceptance to the protocol. The notable non-signers are: The US and Australia.

Under the Kyoto Protocol as the convention came to be called, industrialised countries agreed to reduce their collective GHG emissions by 5.2% compared to the year 1990. The protocol however provided for "flexible mechanisms, which allow it to "solpa adjust madi" its emissions activities. There were three such "flexible mechanisms":

- Joint Implementation (JI) which provides for Annex I Parties to implement projects that reduce emissions, or remove carbon from the atmosphere, in other Annex I Parties, in return for Emission Reduction Units (ERUs).
- Emissions Trading (ET) which provides for Annex I Parties to acquire by trading these certified emission reduction units from other Annex I Parties.
- Clean Development Mechanism (CDM) which provides for Annex I Parties to implement projects that reduce emissions in non-Annex I Parties, or absorb carbon through afforestation or reforestation activities, in return for certified emission reductions (CERs).

Among the above three mechanisms, only CDM is relevant to developing countries such as India.

Clean Development Mechanisms

CDM has been a contentious issue with diverse perceptions. It is supposed to provide an opportunity for developing countries to access modern technology for reducing emissions and receive financial incentives to overcome the barriers.

The logic was that non-annex who have no GHG emissions restrictions at the moment, have financial incentives to develop GHG emission reduction projects to receive "carbon credits" that can then be sold to Annex I buyers, This was apparently supposed to encourage sustainable development.

This payment was not an incentive to these poor countries to continue their low carbon lifestyles, which are seriously under threat due to the onslaught of development. The CDMs only allow CERs for new processes which will reduce emissions even further through the principle of additionality. This the existing low emission lifestyle is not provided sufficient incentives to resist change over to some of the modern systems like concrete houses, or use of fossil and combustion fuels, which is being pushed by the dominant economy.

Further these new CDM projects require more investments, and consultancy services, and procedures all of which have their own carbon footprint, and which financially benefit and support a certain class which itself has a higher carbon footprint.

In fact further the CDMs allows the buyer of the CER, to continue "business as usual" particularly in highly polluting industry or luxury consumption.

Another fear is that at a later stage when developing countries would have to take emission-cuts, the current CDMs would have already used up the low cost mitigation options. And the more expensive mitigation options will be the only ones which the poorer countries would be left with. Perhaps these higher cost options would involve technology flows from the developed countries, at a price.

The CDMs thus enable Annex 1 countries to escape reduction of their fossil fuel based CO_2 emissions domestically, thus to that extent it serves as a disincentive for investments to find alternative paths to fossil fuel based growth.

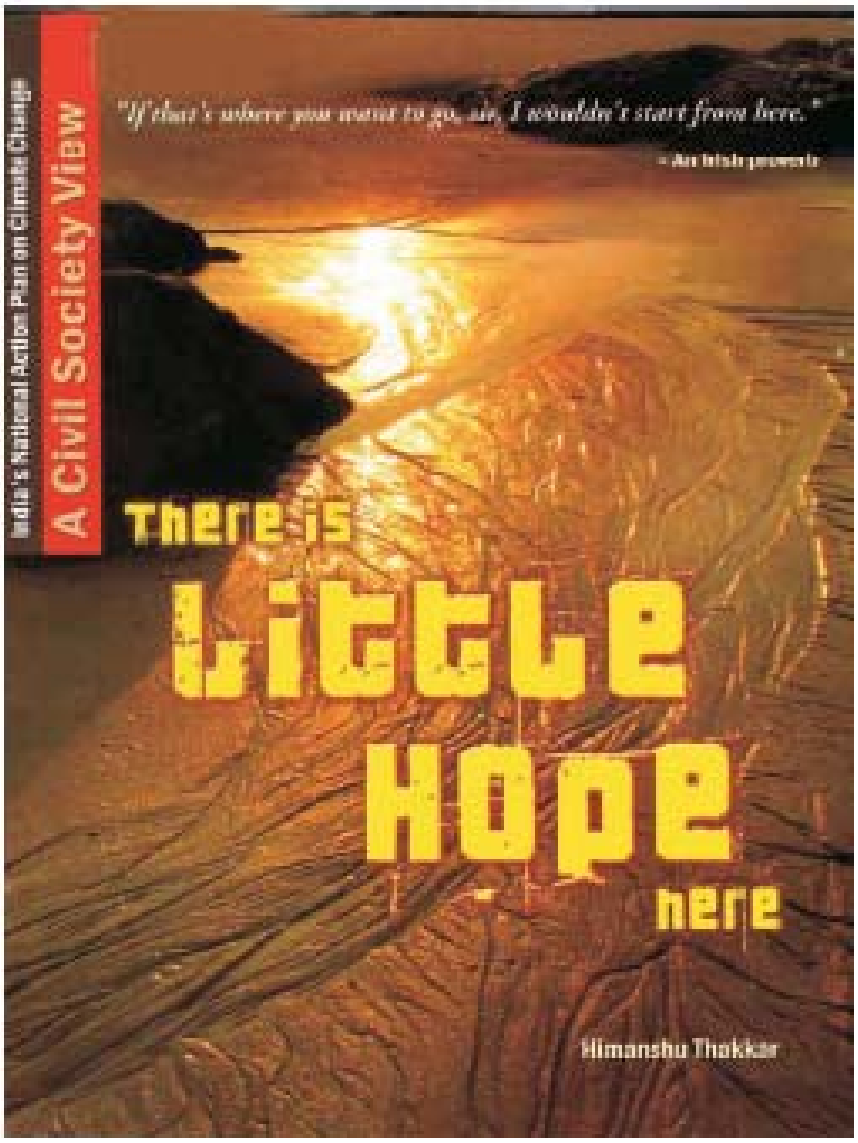
The response from emerging countries

At the International level, governments of developing countries have been quick and correct to point out the blame for climate change on the West. They have insisted on taking remedial measures like reducing emissions, and getting them to transfer technologies to developing countries which are less polluting, and last but not the least allowing mechanisms (like the CDM, and carbon credits), where developing countries get paid for doing additional things that would reduce emissions.

China says that its exports should not count as their emissions and that the receiving country should bear responsibility for it. Given the recession, the US energy secretary has suggested a tariff on imports from countries, like India who do not require emissions cut to "level the playing field". French President Sarkozy favours a carbon tax on imports from nations that have lower environmental standards than France.

India and China in particular have taken a strong stand that they need to develop their economy as because large portions of its population who have carbon footprints much below the optimum level, are living in so called poverty. Their answer is to grow at higher growth rate, which is estimate to add …to the CO_2.

An advertisement at Churchgate station powered by a diesel generator



Coverpage of a booklet by Himanshu Thakkar

III
The Indian Response

"We do not inherit the earth from our ancestors, we borrow it from our children"
- Native American proverb

Climate change is linked to emissions, and in turn, to economic growth. Limiting emissions is then about limiting growth. And so the problem is how is the emissions cake to be divided or shared. Developing countries feel that they cannot forsake the right of their current and future generations to grow economically by accepting constraints on the use of energy.

As already mentioned India has taken the stand that they need to "develop" their economy as large portions of its population, who have carbon footprints much below the optimum level, are living in so called poverty.

The logic is quite correct - namely the emissions by poor who live on the margin of subsistence should be considered a basic human right and should not be counted when ascribing responsibilities for emission reduction. In fact in order to get out of poverty they will need to use energy and perhaps increase their CO2 emissions in some way. Despite its phenomenal growth rate since 1991, India has pledged that its per capita emissions will never exceed that of the rich nations. She feels that she can still grow at 9%.

This is possible only because a vast, huge majority of people is totally out of the fossil fuel economy.

Emissions and Equity

Table 1 shows the distribution of direct and indirect consumption of coal, oil and electricity by different rural and urban income groups and their corresponding carbon emissions. It can be seen that the bottom 50% of rural people emitted in 1990 a mere 54 kg of carbon per person per year. The richest 10% of urban people emitted 12 times as much at 656 kgC per person per year, which is still way below the world average of 1.1 t and much below the average emission in developed countries. This is not surprising if one sees Table 2, which shows that the per capita expenditure of even the urban top 10% income group is only about $1000 in 1990.

Even the projected emission for 2020 show, Table 2, that the bottom 50% of rural population would emit a mere 60 kgC per person per year and the top 10% in urban areas 795 kgC. Their projections assume an annual growth rate of per capita real income of 3.5 %.

Table 1. Per capita Annual Energy Use (Direct and Indirect) 1989-90*

Income Group	Coal (kg)	Oil (kg)	Elec (kWh)	Carbon(t)
RURAL				
Bottom (50%)	74	22.5	95	054
Middle (40%)	127	39.7	152	093
Top (10%) 262	89.8	284	204	
URBAN				
Bottom (50%)	130	45.6	164	101
Middle (40%)	302	118.6	366	246
Top (10%)	765	332.3	858	656
EDR@	10.3	14.8	9.0	12.0

*Excluding energy used directly and indirectly to make deliveries to other than demand for private consumption @ Extreme Disparity Ratio -Urban top/ Rural bottom

Table 2. Per capita expenditure and carbon emissions by income classes in India

Income classes	Emission intensity:Kg of carbon per thousand rupees[b] of expenditure (at 1990 prices)	Per capita expenditure rupees[b] (at 1990 prices)		Per capita emissions (kg of carbon	
		1920	*2020*	*1920*	*2020*
RURAL					
Bottom (50%)	30.6	1764	1964	54	60
Middle (40%)	30.3	3168	3503	95	106
Top (10%)	31.4	6688	9345	209	293
URBAN					
(Bottom 50%)	33.2	2739	3122	90	103
Middle (40%)	35.2	6226	6922	218	243
Top (10%)	36.3	16273	21901	590	795

[b]Direct and indirect carbon emissions due to private consumption of respective classes. Per capita emissions due to other clen of final demand like government consumption and investment is not included.
[b]1US$ -Rupees 17 in 1990
Sources: Murthy et al. (1997a) and Murthy et al. (1997b)

In addition to this inequity, the first half of India lives very highly polluting lives, and does not seem to be taking any responsibility to reduce its emissions.

While only 55 percent of Indian households have access to electricity, annual per capita electricity consumption is increasing every year. Obsolete technologies, air-conditioning and other forms of power consumption, compounded by poor building design, have led to over consumption of electricity, often generated in highly polluting ways. Except for a few green workplaces, office spaces are among the most culpable. Malls are also huge consumers of, usually, 'dirty' electricity.

Within the manufacturing sector, the iron and steel, cement, paper, sugar, textile, bricks and fertilizer industries have the highest emissions. (Centre for Global Change, National Physical Laboratory, 2004)

India's growing transport sector, which relies on fossil fuels, is also a key contributor to carbon dioxide emissions. The number of motor vehicles is growing due to opening up of the country's economy that led to a spurt in private car owners.

Due to an increase in urban population, there is a higher waste collection and dumping, and deeper waste dumps. These processes increase methane generation rates. Large hydroelectric dams release methane into the atmosphere because trees and other plants, plankton and algae settle at the bottom. Methane is produced in the anaerobic (lack of oxygen) conditions prevailing there, over the lifespan of the reservoir. The dissolved methane builds up and is released when water passes through the dam's turbines.

As Sunita Narain, Centre for Science and Environment, one of the first members of CAN, points out that if developing countries have to accept certain constraints to save the world from global warming, it is obvious that all nations and peoples on Earth should share those constraints equitably.

However in real fact we are seeing that all the development activities as well as plans, while aiming to increase growth and therefore emissions, are actually further marginalising the poor and whatever livelihood they may have had.

Can India show the way..

Climate change is being caused by the world's need for energy. The challenge today is that no country has been able to delink growth from a rise in CO2 emissions, show how to build a low carbon economy or re-invent the growth path. Countries like India and China are still building their energy, transport and industrial infrastructure and therefore give the world the opportunity to "avoid' additional emissions. We can build our cities on public transport; our energy security on local and distributed systems - from biofuels to renewable; our industries using the most energy-efficient and pollution-efficient technologies. Our leaders can be key players at this critical juncture. They can provide leadership to the rich and the poor world by showing a different pathway to growth.

As India continues its rapid industrialisation, it is clear that the country's emissions will increase in the future. But the increase without addressing the issue of issue of inequity within the country, is as counter productive as the stand taken by the developed countries.

Major opportunities exist both on the supply and demand side of energy, in case of carbon emissions. In the long run, the results of the modelling exercises show that India, between 2005 and 2035, could supply cumulative 5 billion tonne of carbon equivalent mitigation from the energy options at price below $10 per tonne of carbon equivalent.

India has also has the potential to supply substantial mitigation at a relatively low price. Till the Kyoto Protocol period, substantial potential of mitigation of carbon, methane and nitrous oxides exist at costs below $30 per tonne of carbon equivalent (or $8 per tonne of carbon dioxide equivalent), which is below the prevailing price of traded carbon in European market. The low mitigation cost potential is also evident from the sizable CDM projects being proposed from India in recent times.

India does have the potential to not only deliver these CDMs at low costs, but to mainstream projects which is low carbom emitting as part of the new search of alternatives models of development. This is particularly so while we

re-emphasis knowledge based technologies, but those which has the roots of knowledge and decision in the public sphere. The NGO Lok Vidya thus talks about peoples' knowledge more broadly. It talks about putting the entire services of new knowledge technologies and modern technologies in the peoples' sphere - both in terms of choices of technological development, but also developing those technologies which by their very nature does not lend to or thrive on privatisation of that knowledge. Thus such a knowledge development must take into account the realities of India and the problem of climate change, and work from there..

It is true that there is also scope for the poorer sector to reduce emissions. For example in the agricultural sector contributes to methane emissions. Livestock produce methane in their digestive tracts, and rice crops, emit methane as organic matter decomposes in flooded fields. Other sources include biomass burning, waste and manure, coal mining, and processing of natural gas. While many may argue that these are "survival emissions", there is much to be achieved. The System of Rice Intensification (SRI) is now being popularised, as it is not only a way to increase production, but also reduce methan emissions from flooded fields. Besides the system uses less artificial fertilisers, thereby reductions NO_2 emissions. Bio-gas and non-pesticidal management also has brought in similar benefits. (www.scidev.net).

Thus development has to be grounded on the fact that India is a large developing country with nearly 700 million rural population directly depending on climate-sensitive sectors (agriculture, forests and fisheries) and natural resources (such as water, biodiversity, mangroves, coastal zones, grasslands) for their subsistence and livelihoods. Further, the adaptive capacity of dry land farmers, forest dwellers, fisher folk, and nomadic shepherds is very low.

The Catamaran - A dying craft or the seeds of the future?

IV
A View from the Coast

"Only when the last tree has died, and the last river has been poisoned, and the last fish has been caught, will we realize we cannot eat money"
- Cree Indian proverb

Coastal areas and islands are extremely vulnerable to impacts of climate change. Ocean warming, including coral bleaching and rising seas is already adversely affecting coastal populations and ecosystems. Coasts have been modified and intensively developed in recent decades and thus are even more vulnerable to higher sea levels. Developing countries with their weaker economies and governments face the gravest risks.

The average global sea level has risen by 10 to 25 cm over the past 100 years. Much of this rise is related to a temperature increase of 0.3-0.6°C in the lower parts of the atmosphere. The US National Atmospheric and Atmospheric Administration (NOAA) reported in August 2000 that over the past several decades the world ocean has warmed by 0.3°Centigrade, representing a huge increase in the heat content of the ocean, and consequently in the thermal expansion of the ocean.

The rate, magnitude, and direction of sea-level change will vary locally and regionally in response to coastline features, changes in ocean currents, differences in tidal patterns and sea-water density, and vertical movements of the land itself. Since there are so many factors that influence such environmental phenomenon, scientists have to use different models to calculate the likely rise. These models have predicted a rise between 15 cm and 95 cm by the year 2100. The best model according to the IPCC estimates a 50-cm rise. This rise is due to the thermal expansion of ocean water and an influx of freshwater from melting glaciers and ice. The projected rise is two to five times faster than the rise experienced over the past 100 years. The sea levels are expected to continue rising for hundreds of years after atmospheric temperatures stabilise.

Given the present degree of protection, a sea-level rise of one metre would cause estimated land losses of 0.05% in Uruguay, 1% in Egypt, 6% in the Netherlands, 17.5%in Bangladesh, and up to about 80% for Atoll Majuro in the Marshall Islands.

Impacts in the Coastal Regions

a) Coastal Ecosystem

The impact of Climate Change is not just a matter of sea-level rise and inundation. The entire coastal ecosystem is at serious risk. Coastal areas contain some of the world's most diverse and productive ecosystems, including mangrove forests, coral reefs, and sea grasses. Low-lying deltas and coral atolls and reefs are particularly sensitive to changes in the frequency and intensity of rainfall and storms. Coral will generally grow fast enough to keep pace with sea-level rise but may be damaged by warmer sea temperatures.

Various natural forces will influence the impact that higher sea levels will have. Coastal areas are dynamic systems. Sedimentation, physical or biotic defenses (such as coral reefs), and other local conditions will interact with rising sea-water. For example, freshwater supplies in coastal zones will be more or less vulnerable depending on changes in freshwater inflows and the size of the freshwater body. Flooding and coastal erosion would worsen. Salt-water intrusion will reduce the quality and quantity of freshwater supplies.

The survival of salt marshes and mangrove forests depend partially on the rate of sedimentation being greater or less than the rate of local sea-level rise. Sedimentation is more likely to exceed sea-level rise in sediment-rich regions like Australia (where strong tidal currents redistribute sediments), than in sediment-starved environments like the Caribbean.

b) Oceans

Ocean ecosystems may also be affected. In addition to higher sea levels, climate change could reduce sea-ice cover and alter ocean circulation, patterns, the vertical mixing of waters, and wave patterns. This could have an impact on biological productivity, the availability of nutrients, and the ecological structure and functions of marine ecosystems. Changing temperatures could also cause geographical shifts in biodiversity, particularly in high latitude regions, where the growing period should increase (assuming light and nutrients remain constant).

Finally, any changes in plankton activity could affect the oceans' ability to absorb and store carbon. This could "feedback" into the climate system and moderate or boost climate change.

c) Coral Reefs

With increasing ocean temperatures and higher levels of dissolved carbon dioxide, coral reefs are slowly dying out. Coral reefs are extremely delicate organisms which require extremely precise conditions to survive. Even minute variations in water temperature or acidity levels will kill the reefs, and all the marine life which depends on the reef will die. Due to global warming, temperatures in the ocean have been rising at alarming levels, which are causing the coral reefs to die. The more lethal cause is the dissolved carbon dioxide. Excessive atmospheric carbon dioxide which dissolves makes the water slightly more acidic. As coral reefs are extremely sensitive, a change in the pH level of the water causes the polyps which comprise them to slowly lose their colouration and die. This is called bleaching. Every year, 80-100 per cent of coral reefs which die, die due to bleaching. -Down To Earth, 30/4/2008

omus.files.wordpress.com

In 1998 the coral reefs in the Indian Ocean suffered unprecedented mortality in a mass coral bleaching event as 1998 was the warmest year since temperature recordings began 150 years ago. The high temperatures combined with meteorological and climatic factors resulted in widespread coral bleaching and their subsequent deaths. Massive bleaching was observed in Sri Lanka, Maldives and India with mortalities of up to 90% in many shallow areas. With many of these reefs already suffering from pollution and heavy fishing pressure, recovery will be extremely slow.

Benefits of reefs to the livelihoods of the poor

Reefs are often thought of as mainly providing the poor with fish as a source of food, or as a product to sell. But the benefits of the reef to the poor are far more diverse and multiple, including seasonally stable sources of food, building materials, a medium of exchange, medicines and a source of income and status. It is the reef that often gives rise to islands that provide habitats for people and lenses of fresh water for drinking and agriculture, such as the coral islands of Lakshadweep Union Territory. The reef also protects coastal villages from storms and wave action and provides shelter to lagoons and other productive areas, such as sea grasses and mangroves, which in turn provide a reserve of food in all weather conditions.

d) Disasters

Higher sea levels could also cause extreme events such as high tides, storm surges, and seismic sea waves [tsunami] to reap more destruction.

Flooding due to storm surges already affects some 46 million people in an average year, most of them in developing countries. Studies suggest that this figure could increase to 92 million with a 50 cm sea-level rise, and to 118 million with a one-metre rise.

e) Economic impacts

Sea level rise could damage key economic sectors. A great deal of food is produced in coastal areas, making fisheries, aqua culture, and agriculture particularly vulnerable.

Other sectors most at risk are tourism, human settlements, and insurance (which has already suffered record losses recently due to extreme climate events).

f) Displacement

The expected sea-level rise would inundate much of the world's lowlands, damaging coastal cropland and displacing millions of people from coastal and small-island communities.

Large-scale emigration from coastal zones is expected due to submergence of coast-lines after sea levels have risen. This will create large numbers of environmental refugees especially from low-lying delta regions in poor countries.

g) Health impacts

The displacement of flooded communities, particularly those with limited resources, would increase the risk of various infectious, psychological, and other illnesses. Insects and other transmitters of disease could spread to new areas. The disruption of systems for sanitation, storm-water drainage, and sewage disposal would also have health implications.

V
The Indian Coast

"It seems to me that we all look at nature too much, and live with her too little"
- Oscar Wilde

The Indian coastline stretches over 8118 km and touches eight states and two island territories. States with a coastline include Orissa, West Bengal, Andhra Pradesh, Tamil Nadu, Kerala, Goa, Maharashtra and Gujarat. It is about 5700 kms on mainland and about 1800 kms in the two groups of islands which are most vulnerable. Western coastline has a wide continental shelf having an area of about 0.31 million square km, which is marked by backwaters and mud flats. The East coast consists of the Tamil Nadu, Andhra, Orissa and West Bengal coasts, which are flat, deltaic and rich in mangrove forests covering an area of about 1,430 square km.

Besides these diverse natural and physical features, both coasts have a diverse variety of economic activities, population, industry and infrastructure. The North-West part, comprising the States of Gujarat and Maharashtra, and West Bengal in the North-East part are home to several industrial activities, and trade and commerce, which takes place through major and minor ports. There are 11 major ports and 130 medium ports along the coastline. The concentration of population is high with about one third of the total population living in coastal zone, and it is rapidly increasing. The concentration of human population along the coast is a feature of several other countries, as coasts have for long time been economically attractive destinations of tourism, modern agriculture, trade and commerce, industry and transport services.

In the era of globalisation, the increasing role of trade and commerce is driving societies towards cost-cutting methods and greater productivity in the production of goods. Trade logistics are becoming increasingly important for handling the swift movement of goods. As there are external economies associated with agglomeration in cities and as there are logistical advantages of ports, coasts are becoming favourite destinations for production of goods and organization of trade and commerce. There is a worrying flip side: these processes are exposing themselves to natural and man made hazards, which are now engulfing several coastal cities.

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Sea Level Rise

In 1998, UNEP identified India as one among the 27 countries to be the most vulnerable countries to sea level rise.

An NIO study predicted climate change impacts on sea level:
Mean sea level: Mean sea level rise estimates (using past tide gauge data) were found to be slightly less than 1 mm/yr for most of the stations analysed along the Indian coast.

A TERI study in 1996 estimated that one meter sea level rise along Indian coast would mean that a total area of 5763 square km along the Coastal States of India i.e., 0.41% could be inundated and almost 7.1 million i.e., 4.6 % of coastal population could be directly affected. The most vulnerable areas along the Indian coastline are the Kutch region of Gujarat, Mumbai and South Kerala. Deltas of rivers Ganges (West Bengal), Cauvery (Tamil Nadu), Krishna and Godawari (Andhra Pradesh), Mahanadi (Orissa) and also the islands of Lakshadweep Archipelago would be totally lost.

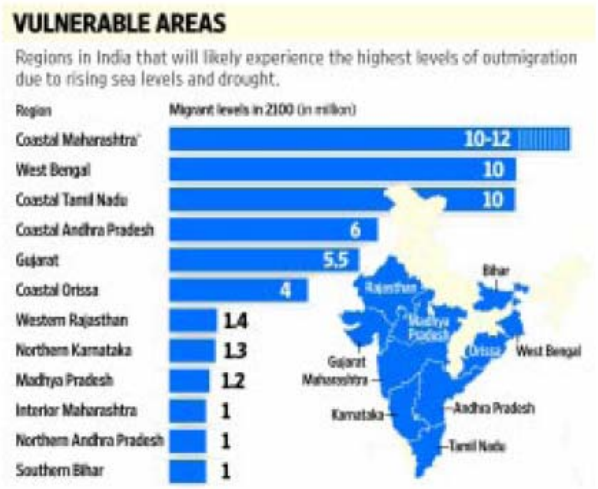
Dislocation of communities

From Bengal To Jharkhand
They belonged to Bengal till one morning they woke up to find themselves in Jharkhand. Now both states won't have them. Bengal won't have them because their village has been submerged under the sea due to rising sea levels caused by global warming. Jharkhand won't have them they have papers showing them belonging form Bengal. Of course, the chars they have fled to to escape the rising sea do not have any civic amenities. 7 lakh people in Malda and Murshidabad have been displaced by rising sea levels and sea erosion. -Business Standard (Mumbai) 19/2/2008

According to IPCC reports, a sea level rise of between 15 cm and 38 cm will displace tens of thousands of people in the country's coastline.

If a one-meter sea level rise were to take place today, it would displace 7 million persons in India (ADB, 1995). In the future many more may be displaced. 35% of the land in Bangladesh would be submerged by a one-meter rise. This is expected to affect Indian as the refugees are expected to come into India.

Sudhir Chellarajan, a professor of IIT-Chennai, has warned that 12 million people from the West Bengal state will be displaced by the end of the century if the factors affecting the climate change are not mitigated.



*around Mumbai
Source: Greenpeace India report, 'Climate Migrants in South Asia: Estimates es and Solutions'

Danti in Valsad district of Gujarat: More than half the residents of this sleepy fishing village have fled. Only the poorest remain on the edge of the village, with just a sea wall for protection. On one side of the wall are lashing waves. On the other are ramshackle, makeshift huts.

Danti is on the coast of south Gujarat, one of the most industrialised areas in India and has some of the country's worst polluted spots such as Ankleshwar and Vapi. Dandi, the site of Mahatma Gandhi's historic Salt March, is 12 km from Danti.
"The fish have gone further into the sea because of [industrial] pollution. And the water has come further in; so we have suffered. We can't go very far in our tiny boats. We used to get 400 to 600 fish in one night. Now we barely get a hundred," says Shantibhai Tandel, a small fisherman.

The villagers along the coast are not sure why the sea is advancing at such a voracious pace. Some fishermen guessed it might be "because there are more storms in the sea". One of the reasons could be a rise in sea level owing to global warming. They don't know what global warming means, but have become "environmental refugees".

Further north, at the estuary of the river Narmada, Kaladra village in Bharuch district is also being nibbled away by the sea. Several houses are broken and hanging on the edge of a cliff of sand that threatens to cave in at any point. A sea wall built 20 years ago is now a relic of the past.- Gone with the waves by DIONNE BUNSHA in FRONTLINE MAGAZINE, 14 JUL 2007

Sea Water Intrusion

In their study "Assessing aquifer vulnerability to sea-water intrusion, using GALDIT method", G. Chachadi of Goa University and Ferreira of National Laboratory of Civil Engineering, Portugal have found that

- The seawater intrusion vulnerability area increases with 0.5m rise in the sea level.
- The surface inundation due to sea level rise is found maximum along the creeks whereas along the main coast it is minimum due to typical topography.

Besides affecting socio-economic fabric of the coastal populace the eustatic SLR can inflict irreversible damages on the coastal freshwater aquifers in the form of seawater intrusion. This could jeopardise the water availability and supply in the heavily urbanised coastal belts, besides irrigated agriculture, coastal infrastructure, tourism and other economic and strategic activities are at risk. Several places along India's 7,500 km-long coastline are experiencing erosion.

In the Sunderbans, two islands have already vanished from the map, displacing 7,000 people. Twelve more islands are likely to go under owing to an annual 3.14 mm sea level rise, which will make 70,000 people refugees. Five villages in Orissa's Bhitarkanika National Park, famous for the mass nesting of Olive Ridley turtles, have been submerged, and 18 others are likely to go under. (Frontline, 14th July 2007)

Bye Bye Beaches

The sea is threatening to chew away the beautiful beaches of Vishakapatnam through erosion. In the past month alone, it has gouged out a 75 metre section of the beach.

- The Hindu, Chennai
18.04.2007

The beach at Puri is slowly disintegrating beneath the approaching waves. Erosion by the sea has the beach reducing significantly in size since recent years, and now the sea is threatening to reach the roads and establishments that were once separated from it by the beach. Geologists studying it said that Puri has never faced this kind of erosion in the past.

Climatic factors and man-made development are inflicting a heavy toll on Goa's coastline with large tracts of beach disappearing beneath the sea. This is damaging the tourist industry as well as the land as the hungry waves come closer to solid ground, threatening to erode all coastal structures near where the beaches once used to be. At Nerul beach, the Mandovi River's embankment has crumbled under the crush of wind and water.

- Deccan Herald
05.07.2007

Monsoon - Changes to India's annual monsoon are expected to result in severe droughts and intense flooding in parts of India. Scientists predict that by the end of the century the country will experience a 3 to 5ÚC temperature increase and a 20% rise in all summer monsoon rainfall.
Climate change studies undertaken so far reveal that action is essential in order to prevent long term damage to India's water cycle. The livelihood of a vast population in India depends on agriculture, forestry, wetlands and fisheries and land use in these areas is strongly influenced by water-based ecosystems that depend on monsoon rains. Changes to the water cycle may also cause an increase in water borne diseases such as cholera and hepatitis, as well as diseases carried by insects such as malaria.

Mumbai

Torrential rain pounded India's financial capital Mumbai in July 2005 causing severe flooding of key thoroughfares across the city, with many people losing their lives. Frequent floods and salt-water intrusion has affected the structural stability of high-rise buildings.

Increase in rainfall and rise in the mean sea level (MSL), in addition to the poor drainage of the city will increase the frequency of floods. Almost one fourth of Mumbai comprises low-lying areas (below or at MSL). Therefore low-income groups and poor residents living in vulnerable locations (accounting for nearly 50% of Mumbai's population) will be affected more.
A conservative estimate shows that about 40% of the population will be affected in the city of Mumbai.

Floods, especially in the low-lying areas of the city, will result in dislocation of people and also deaths.

According to an earlier estimate of a study conducted 10 years ago, the economic damage to Mumbai, the country's financial capital, as a result of climate change could amount to over Rs 2 lakh crore. However, since then, urbanization and investments have only gone up in Mumbai.

Simulations with climate models and observations indicate that rainfall extremes such as the Mumbai deluge of 2005 could become more frequent in India under the impact of climate change. Both 2005 and 2006 had spells of excessive rainfall that normally would have occurred once in about 100 years. It has been observed that till 1989 the average rainfall of Mumbai was 2129 mm. However, in 2005-2006 the average annual rainfall was found to be of 3214 mm, an increase of 50%.

What the climatic modeling has not taken into account, is that most of the low lying areas in Central Mumbai (Byculla to Parel and Dadar) had large mill lands, which even after the Mumbai deluge of 2005, were given to builders to re-construct. Most of these areas were natural sinks for water. In fact when it rained heavily, they acted as lakes till the water drained out into the sea. Today, in 2009, most of these areas have been constructed upon, and even more projects are in the offing.

Unfortunately the has media bought into the story that it was only the people living on the edge of what was earlier the Mithi river, who were responsible for the "slow drainage" of heavy rains. However, if not for the

retainer walls, bunds and diversions of the Mithi sewage at the airport, most of the poor people living there would not have been there in the first place.

Thus development has a way of justifying itself, and passing the buck onto to those who are the victims of the same development. This reality is truer in the case of climate change related disaster.

Eco System

Mangroves are located all along estuarine areas, deltas, tidal creeks, mud flats, salt marshes and extend to about 6740 square km (about 7% of world's mangrove areas). Major estuarine areas located along the Indian coasts extend to about 2.6 million hectares (Gauda & Panigrahy, 1999).

Coral reefs are predominant on small islands in Gulf of Kutch, Gulf of Mannar in Tamil Nadu and on Lakshadweeep and Andaman and Nicobar groups of islands. Ecosystems such as coral reefs, mangroves, estuaries and deltas are rich in biodiversity which play a crucial role in fishery production besides protecting the coastal zones from erosion by wave action.

The mangrove cover in Kerala, though sparse, is relatively better represented in the Kasargod Taluka. Patchy and fringing type of vegetation could be attributed to the microtidal nature, relatively steep topography of the coast. The mangrove exist approx. greater than 1 m above present low water level. Increased sea level may drastically impact mangrove habitats by altering the hydrological features and related processes. The vertical rise in the water column due to sea level rise and the limitations of landward margins may result in water logging, ultimately killing mangroves and associated fauna.- Impact of climate change on mangrove forests along the south west coast: A case study from Kasargod, Kerala, India by Jagtap, T.G. and others

Dying oceans

The Indian Ocean has been identified as being likely to be adversely impacted by global warming and rising marine pollution. The waters around the Indian landmass are at a major risk of habitat loss because of rising sea levels, rising temperatures of the waters and the excessive marine pollution that is being flushed into it. A UNEP report predicts that by 2080, at least 80 coral reefs in the Indian Ocean will die. - Hindustan Times(Delhi) 24/2/2008

Deltas - Climate change is leading to increased salinity and higher tidal surges, permanent submergence of land masses increasing the vulnerability of communities and having an untold impact on the ecosystem and biodiversity of the area. Given the populations potentially involved, this is more likely to seriously affect the major deltas, such as the Ganges-Brahmaputra. In both the cases of deltas and small islands, a likely scenario could be outmigration when disasters due to sea-level rise reach levels or frequencies considered unacceptable. It is at such thresholds that maximum damage and loss of life could be expected.

The Sunderbans is the world's largest mangrove ecosystem spread over an area of 9,630 Sq. Km. in India. The delta consists of 102 low lying islands of which 48 are inhabited. The islands and its ecosystems including the community are severely stressed on availability of natural resources and highly vulnerable to changes in climate. Several factors are responsible for increasing vulnerability of the local community. Studies suggest that climate change is leading to increased salinity and higher tidal surges, permanent submergence of land mass and increased vulnerability of communities and biodiversity. Recent research based on satellite imagery has also revealed that sea level is rising in Sunderbans at an average rate of 3.14 mm a year. A rise of upto 1 metre is expected to inundate about 1000 sq. km. of the delta. In the past two decades four islands (Bedford, Lohachara, Kabasgadi and Suparibhanga) have been submerged with 6000 families rendered homeless.

Voices of the fisherfolk

"We are not able to say why climate has changed, but are experiencing. For example earlier we had a tradition when after we offer coconut to the sea gods on Nariyal Purnima day, the sea would be quiet and allow us to fish. But those days are gone. Now even after Nariyal Purnima we get different kinds of winds, rains and storms. This affects us fishermen.

We do not know the reason for climate change, and we expect government and scientist to look into it. But we cannot rely only on the government and agencies like the metereological department Many times they would give us a warning, and nothing would happen. This means a major loss for us fishermen.

Thus we have to finally rely on our own knowledge and judgement, and take a risk sometimes". (Interview with Prabhakar Ghadigaonkar and Vijay Pereira of CED. March 2009)

The above view of Pradeep Tapke, President of the Vesav Fishworkers Samiti, indicates the kind of dilemma coastal people face. On the one hand there is a livelihood, which has stood them in good stead over a long period of time, on the other is modernization, where their children are educated and are taking jobs in the mainstream. Yet the number of people dependent on traditional fishing, as a livelihood is large and increasing, and is threatened by changes which they can scarcely understand.

Kendrapara and climate change

Village after village in Orissa's coastal Kendrapara district vanishes into the Bay of Bengal. One thing is clear: sea levels are rising, and the people want to know why.

During August-September 2002, scientists at the National Centre for Agricultural Economics and Policy Research conducted a people's perception survey on climate-induced natural disasters in Kendrapara district of Orissa. The district has suffered a number of natural disasters like cyclones and drought. The survey involved 200 households. People's perceptions of disasters are important because they represent the first step towards planning a rational coping strategy to reduce vulnerability.

The survey found:

* Over 90% of respondents felt that both the frequency and intensity of droughts have increased in recent years in the study area, which was almost drought-free till the late-1980s.
* Over 57% of respondents felt there were increased instances of flooding, although a majority of them were of the opinion that the intensity has reduced significantly.
* Nearly 75% of respondents believe that the intensity, not frequency, of cyclones has increased.
* Overall, 89% of respondents felt that the climate had changed, with more erratic weather conditions.

Back in Kanhapur village no new school has come up. It has been over three months since the children stopped going to school. The sarpanch says the government is not willing to invest money in a place that will be washed away in a few years. Local administrative officials refuse to speak, as the situation continues to baffle them. "We don't know why the sea is rising. So there is no need to speak," was the prompt reply of one senior district official.

Side effects of development

In the village cluster of Alappad the callousness is stark. A 16-km strip of land, Alappad is sandwiched between the Arabian Sea and a canal and is, at places, less than 50 m wide. Yet, bulldozers are busy gouging out black mineral sand between the tides, unmindful of an angry sea that is lapping at the village's main road.

Close by there is a park dedicated to the memory of the 33 people who died here in the 2004 Asian tsunami. Alappad was the worst-hit place on the Kerala coast. The tsunami halted sand mining activity, but only briefly. The business continues along the coasts, rivers and estuaries of Kerala despite local protests and court interventions.

In Veli village, the local fisherfolk started protesting against it after their open-air theatre ground was flooded by sea water as a result of mining at a nearby estuary.

Coastal mining can change the contours of the coast and patterns of the waves. "Mine or dig - you lower the level (of the coast)," says M. Baba, director of the Centre for Earth Science Studies located at the state capital of Thiruvananthapuram. "As per the CRZ (Coastal Regulation Zone) norms you cannot take sand from the coast."

"India's CRZ notification of 1991 aims to protect the fragile ecosystem and decongest the coastal area," points out Baba. Environmentalists are now protesting against its dilution to allow more industries, ports and tourist resorts.

Over and above these issues, coastal resorts are now only the latest threat to the coasts.

At Mararikkulam beach in Alappuzha district, land developers have bought up and fenced off the coast, making it difficult for fishermen to land. Building on the land's edge can pollute, kill marine biodiversity and make the coast more vulnerable to disasters.

It is not only coastal land strips and sand dunes that are disappearing due to mining and building, but also the coast's protective green cover. "In my youth I used to sail in the backwaters and the shores were full of mangroves. Now they can be found in just one of two places here," Andrews Ambrose, a fisherman and spokesman for Kerala's fisherfolk, said.

Mangroves grow in coastal swamps and their tangled roots absorb the shock of waves by their spring-like action. "Kerala was one of the safest and best dwelling places, till people decided to do away with mangroves," said A. Mohandas, a mangrove expert in Thiruvananthapuram.

As for the government response, Kerala state fisheries commissioner D. Sanjeevaghosh acknowledged the urgent need to study what climate change will do to the state's coasts. "There should be long-term planning and ecological protection to reduce the disaster risk of coastal areas."

Coastal Management

Most important is the recent Coastal Management Zones (CMZ) Notification, whose ostensible purpose is to protect strengthen ecological security of coastal communities, so as to ensure sustainable livelihood for the fishermen. In November 2008, about 100 representatives from fishing communities of nine coastal districts met and condemned the notification saying it was an open invitation for industries to flourish and drive away the fishermen. The government however says that by providing for planned land use of the coast, it will protect the other areas. Reality however is that several development schemes get pushed through for various reasons giving short thrift to environmental and livelihood concerns. In fact the government is seeking to relax instruments like the Environmental Impact Assessments (EIA), obviously under pressure from the private sector industry.

picture of railway gong at Mahim station Mumbai

"Even when the bell tolls, it's tied down"

VI
What is to be done

"Global warming is not conqueror to kneel before, but a challenge to rise to.
A challenge we MUST rise to"
- Joe Lieberman

Given the increased risk of extreme events and the vulnerability of coastal zone it is imperative that appropriate policy mechanisms are in place in order to reduce the negative impacts.

Some of the policy options include:

(a) Preventive/control measures
  (i) Restrictions on the development activities along the coast
  (ii) Stronger building codes for settlements
  (iii) Detailed implementation practices for infrastructure
(b) Mitigative measures
  (i) Cyclone shelters for protection to people
  (ii) Dykes for protection against surges
  (iii) Drainage systems for better drainage of flood water
(c) Adaptation mechanisms
  (i) Managed retreat - setback zones, shifting of population, relocation and realignment, creating upland buffers and appropriate land use
  (ii) Accommodation methods - institutional strengthening, capacity building, external aid, insurance and local resource mobilization
(d) Financial mechanisms
  (i) Individual, property and crop insurance against natural hazards and
  (ii) Public/group insurance against natural hazards

Among the above measures, preventive/ control methods generally appeal to the administrators but one needs to exercise greater caution given the 'unintended costs and consequences' of such regulation on local systems. Local economies are highly dependent upon the developmental activities and 'blanket' restrictions may work against them, thereby leading to little success of the policy.

Adaptation mechanisms have to play an increasing role in mitigating the likely impacts and it requires a great deal of local participation with the support given by governments at various levels.

Many policy options are available for adapting to sea level rise. Sensitive environmental, economic, social, and cultural values are at stake, and trade-offs may be unavoidable. Until recently, the assessment of possible response strategies and studies have shown that protecting low-lying islands and large delta areas with sea walls and other barriers is likely to be costly.

A fuller range of options would include protection via dykes, dune restoration, and wetland creation; accommodation through new building codes; conservation of threatened ecosystems and regulations against new coastal development.

Other specific examples are dredging ports, strengthening fishery management, and improving design standards for offshore structures. "Integrated coastal zone management" can offer a portfolio of possible responses from which to choose, including social, cultural, legal, structural, financial, economic, and institutional measures. *Source: Climate Change Information Sheet, The Information Unit for Conventions (IUC), UNEP, Switzerland, 1997*

Plan B of Earth Policy institute

Climate Action Plan
Cut Global Net CO_2 Emissions 80% by 2020

- Raising energy efficiency and restructuring transportation
  - ***Buildings***
    Retrofits with better insulation and more efficient appliances can cut energy use 20 to 50%
    Lighting : A worldwide switch to highly-efficient home, office, industrial, and street lighting would cut electricity use 12%, equivalent to closing 705 coal-fired power plants
    Appliances : Japan's Top Runner Program uses today's most efficient appliances to set tomorrow's standards; e.g. helped boost computer efficiency by 99%

  - ***Industry***
    Improving manufacturing efficiency for carbon emissions heavyweights (chemicals, petrochemicals, steel, and cement) offers major opportunities to curb energy demand)

  - ***Transportation***
    Restructuring transport to emphasize rail, light rail, and bus rapid transit, would save energy while making walking and cycling safer
    Moving from oil to electricity reaps big gains

    A New Automotive Economy - Plug-in hybrid electric vehicles (PHEVs) running primarily on emissions-free electricity generated by the wind and the sun would allow for low-carbon short-distance car trips; Combining a shift to PHEVs with widespread wind farm construction would allow drivers to recharge batteries at a cost equivalent of less than $1 per gallon of gasoline

- Replacing fossil fuels with renewables
  Wind
  Solar
  Geothermal
  Other: Small-scale Hydro, Tidal and Wave Power, Biomass

- Ending net deforestation and planting trees to sequester carbon
  Planting Trees
  - v Ending net deforestation by 2020 can reduce annual CO2 emissions by 1.5 billion tons of carbon
  - v Planting trees and adopting less-intensive farming and land management practices can stabilize soils and sequester carbon
    Ending net deforestation

By adding these measures to our renewable energy goals will allow us to reduce net CO_2 emissions 80% by 2020.

Putting a Price on Carbon
Problem: Price of fossil fuels does not reflect costs of climate change, markets not telling ecological truth
Solution: Tax restructuring: Raise tax on carbon emissions by $20 per ton each year, to exceed $200 per ton of carbon by 2020; Offset carbon tax with reduction in income taxes - www.earthpolicy.org

Opting for sustainable development

Sustainable development has become part of all climate change policy discussions at the global level, particularly due to adoption of Agenda 21 and the various Conventions resulting from the UNCED-1992. The generally accepted and used definition as given by the Brundtland support for adaptation planning and implementation, creation of a public-private insurance mechanism and alignment of climate funds and development assistance can be deployed for gaining added benefits.

The Climate Action Network, South Asia (CAN-SA) has recommended in its national level consultation, that both mitigation as well as adaptation measure must be taken. They have strongly suggested that the solutions lie in shifting the emphasis from centralized production systems to decentralized, bioregional production and that any alternative should essentially protect the lives and livelihoods of people. That should be the precautionary principle observed in planning and decision-making.

Heleen de Coninck of the Energy Research Centre, Netherlands, has estimated that the top 50 million people in India, (about the population of France) have emissions on par with the European average. However she accepts that it is difficult to implement separate internationally imposed targets, as that would mean interference in the sovereignty of a nation, something the PM's National Action Plan on Climate Change (NAPCC) needs to take into consideration. This could well be the starting point for developing that low carbon economy, which according to the CAN-SA can be brought about by moving towards decentralized production regime.

However experts have declared that the PM's NAPCC is contradictory. This is because it calls for fast economic growth, which depends on power and transport, which accounts for 40% GHG emissions in the first place. It highlights the fact that marginalized communities who have low emission lifestyles, and are the first to suffer the impacts of climate change are not being directly addressed in the programmes on climate change. In fact their low emissions allows the government to make sanctimonious claims that the per capita emissions would never exceed that of the developed countries.

The least that the NAPCC could have done would have been to include climate change as one of the components of the Environment Impact Assessment requirements for new projects. That aside, 687 mining projects and 316 special economic zones and other projects like Coastal Corridors have been sanctioned without taking the impacts of Climate Change into account.

A Gender & Livelihood based approach

The Food and Agriculture Organization has developed and tested a livelihoods-based approach to climate change adaptation processes. The approach recognizes the need for people's livelihood priorities to be met; and also the importance of incorporating local knowledge and traditional practices in science-based climate prediction information. The 1.4 billion rural people who depend on rural small-scale and resource poor farming (and fisheries) in developing countries are highly vulnerable, and extreme events severely affect their livelihoods, food security and well being.

Interventions to protect livelihoods from external shocks are more effective when a gender dimension is taken into account, as these shocks affect women differently from men.

In order to move forward with gender sensitive policies, more locally based research is needed on climate change. This research should seek to explore fundamental questions regarding the effects of different kinds of climate change, for example flooding as opposed to drought, and how these affect women differently from men in each case.

Based on their distinct roles, women and men have different sets of knowledge and skills, such as knowing which seeds to plant during a dry spell or knowing how to dig a well. Recognizing their contributions will result in a wider range of options for preparing for and coping with change. Participation in decision making and politics, and access to decision makers is not always equal for men and women and this may affect their participation and the representation of their ideas in short- and long-term decision making on climate change.

Key gender concepts:

1. Gender refers to the social roles and relations between women and men. This includes the different responsibilities of women and men in a given culture or location.

2. Gender roles of women and men are socially constructed, unlike the sex of men or women, which is biologically determined, and such roles can change over time and vary according to geographic location and social context.

3. Gender equality means “equal enjoyment by women and men of socially-valued goods, opportunities, resources and rewards. Where gender inequality exists, it is generally women who are excluded or disadvantaged in relation to decision-making and access to economic and social resources. A critical aspect of promoting gender equality is the empowerment of women”.

Taking a gender perspective into the policy design process requires making the concerns and experiences of both women and men an integral dimension of the design and implementation, monitoring and evaluation of policies and programmes. Gender analysis can be used to understand women’s and men’s different activities and responsibilities, and their access to resources and decision-making, making programmes more efficient and relevant.

Basics of a gender cum livelihoods approach

* Use participatory approaches to involve all members of the community in planning.
* Understand local gender roles, including different vulnerabilities (Failure to consider these differences between men and women leads to unsuccessful project activities).
* Draw on local knowledge, which is linked to gender-differentiated roles, and "is based on experience and adapted to the local culture and environment, it is continuously developing [and is] an important asset for resource-poor people."
* Enhance local capacity to adapt.
* Introduce tools in a locally sensitive way.

Action on the gender dimension of climate change is needed at the policymaking level. With recognition that there will always be a degree of uncertainty about the impacts of climate change, global preparations for the range of possible impacts must incorporate the gender dimension of climate change.

Empowering the vulnerable with information

Most of the international negotiations, policy-making and funding keep in view the long-term effects of climate change, on the scale of decades. Meanwhile, vulnerable communities are faced with changes in climate every month, every season and every year. There is only a hazy understanding of the local risks and consequences of the climate threat. Local communities have an urgent need for more information in order to cope with short-term 'climate variability'. At the same time it has now become extremely crucial to understand the sensitivity and vulnerability of the environment and society to climate change. Knowledge emanating from local sources is more likely to be understood, trusted and integrated into action plans and programmes.

Climate science demands new approaches. It demands breaking away from what is already known to discover what needs to be known. Most of all it will require active engagement with the ordinary people. People will need to pay careful attention to everyday events and meticulously observe scientific processes as they play out in our gardens, in our agricultural fields and in our glaciers.

Change begins with me

Though uncertainties are large one thing is certain: the nature and impact of climate change on the coastal people will depend on what we do and the choices that we make. We cannot solely rely on governmental agencies, scientists and the market forces to act.

While most of the activities of coastal communities have low carbon foot-prints, there are several areas where we could do our bit to reduce our carbon footprint even further. We have changed over to fossil fuels, as they are relatively cheaper and easier to handle. We no longer use the sun and wind as potential energy sources (solar cookers and heaters etc.). We have also tended to ignore our local markets, and set up structures which will send our catch to more distant areas. We have also tended to go in for exotic high energy tools and habitat. We have been made to believe that consuming these exotic products somehow represents the good life or that it is the most efficient and economic way of organizing things. In actually we have only increase the risks of climate change to our future generations.

At the same time, we must also recognize that reducing green house gas emissions may only mitigate some of the impacts on the coast, and delay others. Because of the long lifetime of the greenhouse gases already present in the atmosphere, some impacts are inevitable. Therefore it is critical that we go in for adaptation or coping with climate change impacts, is increasingly being recognized as critical. Adaptation should be aimed at reducing the vulnerability and improving the adaptive capacity, or resilience, of people who rely on climate-dependent resources for their livelihoods.

We will also need to fight for a wider coastal management system, which is based on decentralized planning, and choices made in our own bio-regions, by our panchayats samitis Unions and other civil society organizations and NGOs.

We still have a chance to protect our planet from ourselves. Let us use it well.