

Thinking about and responding to Climate Change

Why and how should we care?

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WHEN I give an introductory lecture on environmental issues to a general audience, I often begin by asking people to list out the most pressing environmental problems. I then take the phrases tossed out, such as 'deforestation', 'water scarcity', 'air pollution', 'ozone hole', or 'biodiversity loss', and organize them into two contrasting groups: 'resource scarcity' versus 'pollution', or 'Southern (developing)' versus 'Northern (developed)', or 'empty-stomach' and 'full-stomach'. I then go on to discuss how these categories are useful, as they highlight different perspectives on the 'environmental crisis', but are also limited, as developing countries such as India are hit by both kinds of problems.

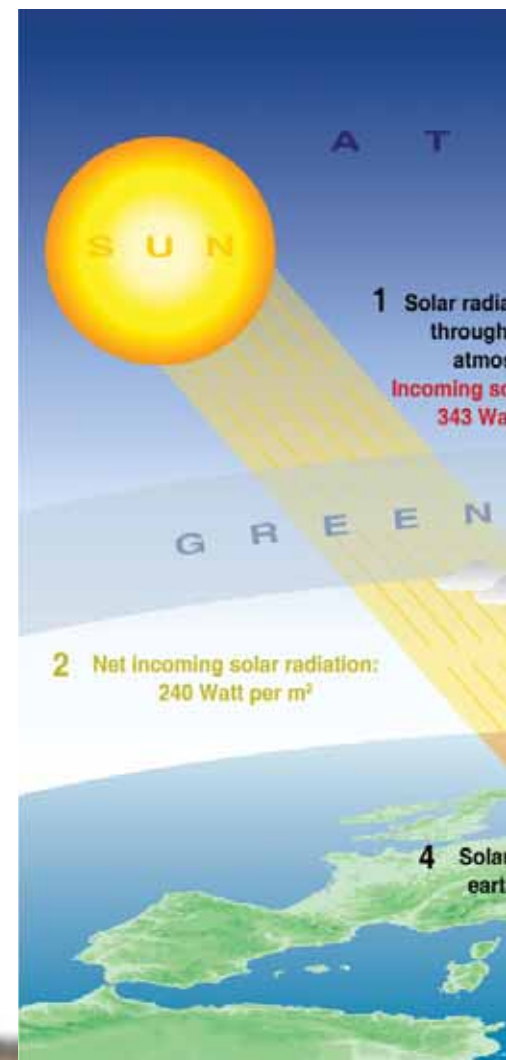
I have been doing this exercise off and on for more than 20 years now, with audiences in Indian colleges and American universities, with students, teachers and activists. One trend I have noticed is the increasing 'northernization' of Indian audiences: so ozone, biodiversity and climate change pop up immediately in the list, while water scarcity and firewood

scarcity are mentioned much later (if at all). And of course, there is a phenomenal rise in the prominence of 'climate change' in the list – these days it is often the first one to be mentioned. A third tendency is to use CO₂ emissions and air pollution interchangeably, and to think of tree planting as a panacea for all environmental ills. With the Indian 'mindspace' being increasingly colonized by concerns and ideas emanating from a 'globalized' (read 'westernized') media that also believes in over-simplifying issues, are we in danger of forgetting the more pressing and still unsolved issues closer home? Is climate change really an important problem for Indians to focus on? Why or in what way? And are we thinking about it rigorously enough?

The science of climate change

At the core of what we currently call Climate Change (CC) is the greenhouse effect. This effect originates from the fact that certain gases (primarily CO₂, water vapour and methane) absorb (and re-radiate) infra-red radiation emanating from the Earth's surface, thereby trapping some of the heat that would otherwise have escaped.

Note that in the absence of the atmosphere and the greenhouse gases (GHGs) in particular, the Earth's temperate would have been -17°C, making life on earth impossible. Thus, GHGs have a crucial positive role in our lives.* The basics of the greenhouse effect are depicted in Figure. A vast amount of information is now available on this subject,



*Note that the term 'greenhouse' effect is slightly misleading: greenhouses that are used to grow vegetables in cold climates stay warm because they trap the air and prevent it moving up after heating up (convection), not by blocking outgoing radiation.

including www.ipcc.org <http://climatechangeeducation.org/science/index.html>.

There are many reasons why this climatic balance could shift. Sunspots increase solar radiation periodically, typically every 11 years. Changes in the earth's orbit (distance from the sun), axial tilt and precession that occur on cycles of about 12,000 to 100,000 years have been the cause of periodic ice ages in the past. The current CC problem, however, originates from an unprecedented increase in certain GHGs, particularly in CO₂ and methane. CO₂ concentrations in the world's atmosphere have risen from a 'pre-industrial' level of about 250 parts per million (ppm) to 380 ppm today. This

increase has taken place since the 1800s, and can only be the result of human activities, primarily the burning of fossil fuels (coal, petroleum, natural gas) and to some extent deforestation. It has also been shown that although some of the CO₂ emitted since the 1800s has been absorbed in the oceans, the rest is accumulating in the atmosphere.

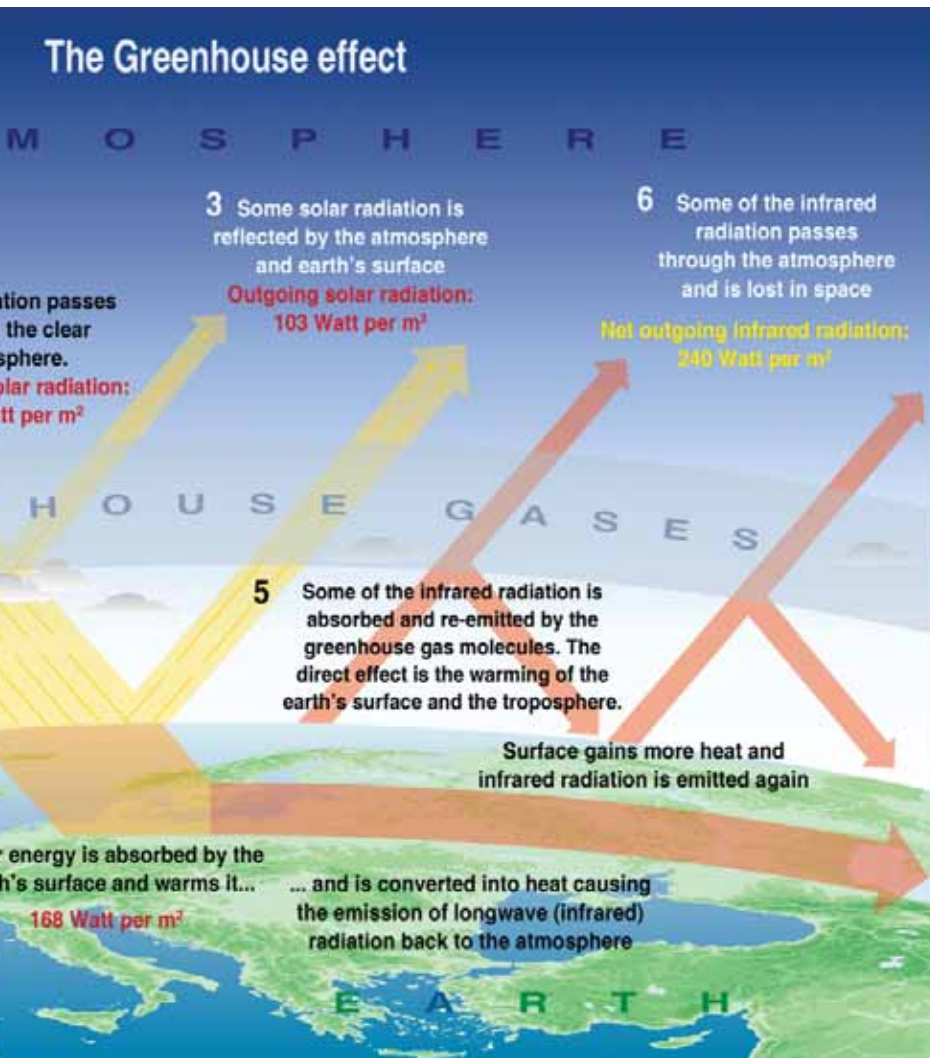
Scientists have used a fascinating array of data and methods of analysis, and come to the same conclusion: that the global temperature is increasing, that it is strongly linked to increases in CO₂ in the atmosphere, and that this increase is caused by humans (see http://www2.sunysuffolk.edu/mandias/global_warming/). Yet one finds right-wing US-

based think tanks such as the Liberty Institute holding seminars across the world, arguing that the climate is not really warming up, or if it is warming up that is because of sunspot cycles or other natural phenomena and not because of fossil fuel use, and in any case the climate system will re-adjust easily. Teachers at all levels need to educate themselves about these glib arguments and their flaws.

Almost equally problematic is the misconception about what role 'trees' can play in reducing CC. Trees sequester carbon as they grow, but stop sequestering beyond a point, and all the sequestered carbon is released back as CO₂ (or worse, methane) when the tree dies and decays. For tree planting to play a net positive role, an area that did not earlier have trees must be planted and then kept tree covered *in perpetuity*. Even then, one tree may only sequester a few kilograms of carbon per year, so one needs to plant (and maintain) a lot of trees (say 1 hectare with 1000 trees) *each year* to offset just the emissions of 1 average Indian. Imagine how much land we would require to offset the emissions of the 10 million richest Indians, not to mention the 200 million Indian middle class?

Why is it a problem?

One might wonder why a 1°C increase in average global temperatures would be such a cause for concern. Wouldn't many cold countries welcome such a change? And even in India, what does 1° matter when we are already roasting in 45° heat in some parts? Indeed, in the early days of discussion on climate change, several temperate countries such as Russia felt it might benefit them. However,





the Earth's climate system is so complex that we have now realized the repercussions are multiple and could cascade into something dramatic. For instance, where glaciers are just at freezing, one degree can cause them to melt permanently and that ice on land will end up as water in the oceans. A negligible addition, did you say? Well, firstly, glaciers and snow cover in the Himalayas ensure that winter snowfall feeds the Indo-Gangetic plain in the summer. Secondly, a small amount of warming might make entire ice sheets slip off the Antarctic land mass into the oceans, raising sea levels by several metres. Thirdly, too much fresh water entering the Atlantic suddenly may change


salinity levels, and stall the Gulf Stream, which brings warm water from near the equator to northern Europe. Fourthly, declining snow cover globally may reduce the Earth's whiteness and therefore its ability to reflect sunlight (called albedo) to lead to further warming. Similar complexities and feedbacks abound in many other parts of the climate system, which is why scientists now use the term climate change, and not global warming. (see http://www.democracynow.org/2008/7/3/global_disruption_more_accurately_describes_climate).

Moreover, the impacts are very unevenly distributed, and poor tropical countries are likely to be worse hit than many others.

While initially it was thought that climate change might benefit India through increased rainfall, it has now become clear that the impacts are going to be quite negative. The melting of Himalayan glaciers has now been well established by our own ISRO. A country like India with large areas of rainfed agriculture that depend upon the monsoon rains is extremely vulnerable to unpredictable changes in the monsoon – and rainfed farmers are already amongst the poorest in rural areas. Moreover, India has a long and densely populated coastline, which could be dramatically affected by sea-level rise. Small island nations could even drown completely! The



Melting Himalayan glaciers



capacity of developing countries to adjust or adapt to climate change is also much lower: a person in the USA might simply crank up the air-conditioning, but what does a person living in a slum and already vulnerable to summertime heat-waves do?

Who caused it? Who should fix it?

At one level, assigning responsibility for causing climate change should be very straightforward. CO₂ is the major GHG, and fossil fuel burning has been the major source of CO₂ in the past two centuries. The industrial revolution was powered by fossil fuels – initially coal and then petroleum and natural gas. Thus, all artefacts and users of those artefacts that came out of this revolution are party to CC: cars, trucks and trains, coal-fired power plants and air-conditioners that draw power from them, steel mills and cement factories, LPG-based cooking, and so on. Even traditional lifestyles can cause some CO₂ emissions: for instance, if firewood use leads to permanent deforestation, or when forests are replaced by pastures. It should then be obvious that the bulk of the responsibility lies with industrialized societies and therefore with heavily industrialized countries. Since the 1800s, industrialized countries, containing about 1/5th of the world's population, have contributed 2/3rd of the total CO₂ emitted globally. Even today, in spite of all the growth that has taken place in China and India, more than 50% of the annual global emissions of CO₂ still come from developed countries. Most important, if one factors in the population that is emitting this CO₂, India's emissions are below 2 tCO₂eq/capita/year while those of the USA are at 24 and

the European Union as a whole is above 10. Yet, there are many controversies in the international debate on responsibility.

Firstly, GHGs differ in their effectiveness in blocking infra-red radiation, and also linger in the atmosphere for different periods of time, so the net impact of emitting one additional molecule of a GHG in terms of its contribution to trapping radiation varies. For instance, a molecule of methane is much more effective than a molecule of CO₂, but CO₂ stays much longer in the atmosphere. For a meaningful discussion on human contributions to climate change, scientists have to come up with a common measure, which is called Global Warming Potential of each GHG. The definition of GWP is necessarily somewhat arbitrary, especially in terms of what time frame is considered. Using a short time frame in this calculation pushes more blame on methane-emitting developing countries than longer time frames, as the Delhi-based Centre for Science and Environment pointed out early on (see <http://www.indiaenvironmentportal.org.in/books/global-warming-unequal-world-case-environmental-colonialism-and-a-host-of-other-excellent-analyses-at-www.cseindia.org>). After much controversy, countries have agreed to use a 100-year time frame to calculate CO₂ 'equivalence' of methane and other GHGs (which leads to the unit 'tonnes of CO₂eq').

Secondly, should historic emissions be considered in assigning responsibility? Many of us living in India, having suffered the colonial yoke, would say 'yes' for a variety of reasons: those who benefited from industrialization

should also be willing to pay its cost. Moreover, industrial countries did not just 'happen' to get industrialized first, much of their industry was fuelled by resources extracted from colonies. The poverty in developing countries can be traced substantially to colonialism. And surely, each person has a right to a minimum quality of life, to some 'survival emissions'. So emissions per capita (either current or cumulative) seems a much more just measure of responsibility than simply emissions per country.

On the other hand, industrial countries argue that they cannot be held responsible for emitting CO₂ when it was not known to be a pollutant. The only international agreement reached so far on climate change (the Kyoto Protocol) also ignored historic responsibility and asked for minuscule reductions in emissions from the top industrialized countries. Even suggestions that equal rights per capita be enforced gradually, allowing large emitters time to reduce their carbon footprint, has not met with agreement. Some even argue that being located in temperate regions, developed countries have a right to more emission because they need to stay warm, forgetting that by the same argument, Indians would be demanding huge emission rights for staying cool in a hot climate! Calls for industrialized countries to provide financial and technological support to developing countries in return for writing off any historical climate debt have of course fallen on deaf ears. Indeed, the USA in particular did not even sign the Kyoto protocol and is working actively to subvert any agreement that will require them to seriously reduce their domestic emissions.



Instead, they have tried to target China and India as being part of the biggest emitters (which is largely an artefact of their large populations). Thus, no reasonably fair global agreement on CC seems to be in sight. (see www.ecoquity.org for more details).

And there is of course the debate over what constitutes a 'sustainable level of emissions'. Given the enormous uncertainties about how climate might change over the next (say) 100 years, what effects it will have, and to what extent in the long run (say 500 years) the climate system will equilibrate and absorb current GHG emissions, the answer to this question varies tremendously. Should we try to limit temperature change to less than 2°C? How much time do we have to do this? What does this mean in terms of how much we can emit between now and then? And then of course how should this 'carbon space' be allocated across countries or regions or communities? There appears to be a loose consensus amongst many scientists that a temperature rise about 2°C may cause 'runaway' climate change with possibly catastrophic impacts, and further, to do this requires containing global GHG concentrations to under ~450ppm (or CO₂ under 400). But even these estimates may turn out to be over-optimistic.

Engaging with CC

CC is thus a peculiar problem: it is truly global in the sense that virtually everyone contributes to it, and virtually every one is affected by it. This requires genuine global cooperation – we can do nothing to unilaterally solve or even make a dent in the problem. Even if India were to completely stop using fossil fuels tomorrow, our glaciers

would continue to melt and our coast would still get inundated. The major responsibility for mitigation lies with developed countries, as also the need to help developing countries to adapt or 'climate-proof' themselves to a small degree. And yet, developed countries (particularly the USA, Canada, Australia, Japan, and Russia) have refused to accept any significant part of this responsibility. Any international negotiation seems to lead to more pressure on us to 'start cutting back', but hardly any commensurate efforts from the major emitters. Moreover, these emitters want to 'outsource' whatever little emission reduction they promise by paying for (say) planting trees in India. And many governments, including the Indian government, are jumping at these 'carbon trade' deals without insisting on an overall fair agreement on who is required to reduce how much.

How then does an Indian citizen respond to CC? Should we call it a 'Northern conspiracy to keep us underdeveloped' and simply ignore it, and pursue our economic dream? Should we get scared by the impending CC impacts and put pressure on our government to sign any deal that will lead to softening the blow? Should we look at it cynically as a great opportunity to make some money planting trees or rather to channel money to state forest departments to fill the same old holes with new saplings? Should we use it as an excuse to build more Koodankulam-type nuclear power plants and brush aside their environmental risks because they are supposedly 'carbon-neutral'? Should we preach the 'plant-more-trees' mantra to our children while we all sit in front of TVs and get brainwashed into consuming

more cars, more gadgets and more air travel to 'eco-tourism' destinations around the world?

Probably none of these approaches will make sense to a thinking person. It is true that most Indians are below any reasonable estimate of 'sustainable per capita emissions'. But it is also true that we, as a country and a society, have adopted the same model as the developed countries: industrialization and consumerism to drive economic growth. We are already seeing the environmental impacts of this model – declining water levels, polluted air, and displaced people. Climate change should be seen as the last straw on the camel's back, a wake-up call that should make us question the model we have blindly adopted. Calculating one's carbon emissions may not be the most relevant thing to do to improve our local environment or to soften our indirect footprint on the lives of tribal and other communities in India's hinterland. But because carbon calculations are relatively simple (see, e.g., <http://www.cleanindia.org/carbon/ClimateChange.htm>), and because carbon emissions are strongly correlated with other kinds of resource use, they provide us an entry point into looking at our lifestyles and the systems of governance that promote them.