

CLIMATE CHANGE: CAUSES, CULPRITS AND CURES

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The speedy developing world has led to vast inequalities, leaving almost three-fourths of the world's people living in less developed countries and one-fifth below the poverty line. Establishing more and more industries and adopting the ever-growing technologies blindly has exploited the limited resources and has damaged the environment. The potential development has to be more conscious of its long-term impact. The problems are complex and the choices narrow. We have to be fair to the next generation by providing them a healthy air to breathe in and an inheritance of wealth no less than we inherited. The path on which we are running to catch more and more development has to be sustainable if we want the benefits of development to be long lasting.

The dictionary meaning of the word 'sustain' is 'to maintain' or to 'keep up'. Sustainable development can be defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The scope of sustainable development has widened vastly and it includes some social aspects and technological aspects too. But the primary focus remains on its environmental aspect and rightly so.

The International Energy Agency (IEA) has warned that India is going to become the third biggest emitter of CO₂ by 2015. The fourth assessment report of Intergovernmental Panel on Climate Change (IPCC) reported that enough Green House Gases (GHGs) have already been emitted to cause a rise of around two degrees by 2050, warning of extreme weather events like drought, floods and rise in the sea level due to melting of glaciers. (IPCC Fourth Assessment Report, 2007) This threatens the very existence and livelihood of coastal communities, especially in poor countries. The facts are sufficient to show that we are already running short of time to take concrete steps in the direction of sustaining our fast changing climatic conditions.

Human activity around the globe has reached a level where it is beginning to affect the earth's climate. Climate change means the change in climate overtime, either due to some natural calamity or due to some human activity. It means that climate change is a disruption in the normal running of the climatic conditions. It is something unnatural. According to IPCC reports, 1996, climate change occurs because of internal change within the climate system or in the interaction between its components, or because of changes in external forces

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either for natural reasons or due to human activities. Climate changes due to excessive burden of world population and industrial activity. In recent times, the problem of green house gases has assumed a mammoth form.

The GHGs present in the atmosphere allow incoming ultraviolet solar radiation to pass through smoothly, but partially absorb and reemit outgoing infrared terrestrial radiation. This is a natural process. But excessive industrialization and limitless exploitation of resources has increased the concentration of GHGs beyond their natural limits. Table 1 shows the increasing concentration of GHGs due to intensive industrialization in the world. These gases keep the earth some 33°C i.e. 60°F warmer than it would otherwise be. Excessive concentration of these GHGs cause the earth to become warmer. This is global warming. As is shown in table 1, one major contributor in the concentration of GHGs is industrialization. The first three GHGs are emitted to the atmosphere by both natural and anthropogenic sources, while the last one occurs only as a result of industrial activity. The data has been shown in parts per billion volume (ppbv).

Table 1. Main Green House Gases

Green house Gases	Chemical Formula	Pre-industrial concentration (ppbv)	Concentration in 1994 (ppbv)	Anthropogenic sources
Carbondioxide	CO ₂	278000	358000	Fossil fuel combustion, land use conversion, cement production
Methane	CH ₄	700	1721	Fossil fuels, rice paddies, waste dumps, livestock
Nitrous Oxide	N ₂ O	275	311	Fertilizer Industrial processes combustion
CFC-12	CCl ₂ F ₂	0	.503	Liquid collants foams

Source: Carbon Dioxide Information Analysis Center Annual Report (CDIAC), 2000. as quoted by Mukhopadhyay Kakali (2003)¹

The increasing concentration of GHGs as shown in table 1, cause the earth to become warmer. One fact that the above data shows is that one of the major factor contributing in global warming is increasing industrialization.

Let us see which are the major industrial pollutants that contribute in the concentration of GHGs and ultimately in increasing global warming. Table 2 shows some 'representative' processes from selected industries and identifies major pollutants associated with each process.

Table 2. Some of the process-related pollutants in selected industries

Industry	Process	Major Pollutants
Iron and steel	Coke making	Sulphur dioxide, hydrocarbons, ammonia, oil, grease
Petroleum Refining	Drilling	Mud, salt water, free emulsified oil, natural-gas, oil spills
	Crude Separation	Carbon monoxide, ammonia, hydrocarbon, desalted water
Leather Tanning	Drying Operation	Solvents, ammonia
	Tanning	Oils, ammonia nitrogen
Pulp and Paper	Pulp Mill	Bleaching chemicals, clay, ink dyes
	Wood preparation	Suspended solids, bark refuse, sand dust
	Kraft Pulping	Suspended particulates, sulphur compounds
	Papermaking	Suspended solids, dissolved solids
Textiles	Yarn and fabric manufacture	Total solids
	Wool finishing	Chlorine, sulphate, ammonia
	Raw Wool scouring	Grease, pH
	Woven Fabric finishing	Suspended solids, oil
	Knit Fabric finishing	Oil, grease, dye carrier

Source: Park Se Hark and Labys C. Walter (1998)²

Industrialization contributes in increasing pollution in two ways. The first one, which we discussed in table 2, is process related pollution. There are certain processes involved in the making of certain products like paper, cloth, shoes etc that give birth to some very hazardous pollutants. The second one, which is equally prominent, is the disposal-related pollution. Table 3 shows some hazardous industrial wastes along with their source.

Table 3 : Category and source of hazardous wastes

Category	Source
Toxic chemicals	Chemical industry, heavy industries, coal-based thermal power plants, pharmaceuticals, pesticides, plastic and polymers
Flammable	Oil sludge, solvents, light metal discards
Explosives	Ordnances factories, oil tankers, safety matches, pyrotechnics
Corrosives	Acid slurries

Source: Park Se Hark and Labys C. Walter (1998)²

The above said pollutants, when disposed off, either create water pollution or contribute in air pollution. Some examples of industrial water wastes are given in Table 4. This table shows that various industries like Brewery and Distillery, in its process of fermenting liquors results in some wastes like Organic lead. Other industries like chemicals, food processing and meat packing also lead to certain types of wastes which are not environment friendly.

Table 4: Selected examples of industrial water wastes

Industry	Process or Waste	Result
Brewery and Distillery	Malt and fermented liquors	Organic Lead.
Chemicals	Various	Stable Organics, Acids.
Dyeing	Sizing, Bleach	Color, acid.
Food- processing	Canning and Freezing	Organic Load, acid.
Laundry	Washing	Alkaline
Leather-tanning	Leather cleaning	Organic load, acid, alkaline.
Meat packing	Slaughter, preparing	Organic load
Paper	Pulping	Waste wood fibers
Steel	Pickling, Plating	Acid

Source : Park Se Hark and Labys C. Walter (1998)²

These wastes, when disposed off in water, results in the formation of fatal matter like lead or phenols etc.

That was the role of industrialization as the main contributor in polluting our air and water resources up to such an extent that it is causing our climatic conditions to fall on the negative side.

Who is responsible for Climate Change and up to what extent

The industrially developed nations have been emitting CO₂ far more than developing countries but the data shows that even developing nations have also started emitting large amounts of CO₂ as they follow the fossil fuel-intensive economic growth model set out by the rich countries. But still, countries like USA and Canada are far bigger culprits than countries like India and China. In a seminar held in 2007, CSE (Center for Science and Environment) Director Sunita Narain, said “ The world has to think big and not in the small, petty way it is thinking till now. Even if India cuts all emissions and China stops breathing, climate change cannot be stopped unless rich countries take big action.”(Sharma Vibha “2007”)³. And following such big action, the year 2007 saw US also coming in line that once being one of the biggest emitter of greenhouse gases

(GHGs), had also been evading the Kyoto Protocol. Indian Planning Commission Deputy Chairman Montek S. Ahluwalia said recently that if the emission by US and Europe together, is 15 tonnes per capita then by 2050, it would be obligatory for them to reduce it up to 3 tonnes. India is emitting just one tonne per capita. If it reduces 20 percent by 2050, the figure would come down to 0.8 percent, which would still be far lesser than the developed countries. So, if we look at per capita emissions of CO₂, the differences in developed and developing countries are even more apparent as shown in Table 5. This is because of energy intensive lifestyle of industrial countries.

Table : 5 Comparison of per capita emissions of USA and South Asia

Country	Per capita emissions (tc)1990	Per capita emissions (tc) 1996
USA	5.18	5.37
Bangladesh	0.04	0.05
Bhutan	0.02	0.04
India	0.22	0.29
Maldives	0.19	0.31
Nepal	0.01	0.02
Pakistan	0.16	0.18

Note: tc: tonnes of carbon

Source: Mukhopadhyaya Kakali (2003)¹

India's 2004 total fossil-fuel CO₂ emissions rose 6.3 percent over the 2003 level to 366 million metric tons of carbon. From 1950 to 2004, India experienced dramatic growth in fossil-fuel CO₂ emissions averaging 5.8 per year and becoming the world's fourth largest fossil-fuel CO₂-emitting country. Since 1990 Indian total emissions have almost doubled. Fossil-fuel emissions in India continue to result largely from coal burning with India being the world's third largest producer of coal. Coal contributed 87 percent of the emissions in 1950 and 70 percent in 2004: at the same time, the oil fraction increased from 11 percent to 22 percent. Indian emissions data reveal little impact from the oil price increases that affected emissions in the United States and Western Europe so dramatically in the late 1970s and early 1980s. With the world's second largest population and over one billion people, India's per capita emission rate for 2004 of 0.34 metric tonnes of carbon is well below the global average (1.23) and the smallest per capita of any country with fossil-fuel CO₂ emissions exceeding 35 million metric tonnes of carbon.

What the nations are doing to cope with Global Warming or Climate Change

Though the issue of global warming was hot even in sixties, but the first major step was taken in 1979 when the first World Climate Conference was organized. With the establishment of IPCC in 1988, the UN came directly in contact with the problem. It was after this that an international protocol called the Montreal Protocol of Substances that deplete the Ozone layer came into force in 1989, which aims at reducing and eliminating the production and use of the controlled Ozone depleting substances, including CFCs.

The summit held at Rio De Janeiro in 1992 was a landmark on the issue of global warming. The treaty was adopted on 9th May 1992 in New York. The next instrumental step was taken in Dec. 1997 in the form of an international conference involving world leaders at Kyoto, Japan. At this conference, the participating nations attempted to agree on reducing Green House Gas (GHG) emissions that would be legally binding on nations. But there were many ifs and buts on the issue of reduction commitments fixed for developed and developing countries. Despite all the hue and cry, the conference produced some results in the form of a draft called “Kyoto Protocol” which committed developed countries to reduce their collective GHG emissions by 5.2 percent from 1990 levels during 2008-2012. The developing countries argued that only industrialized countries are responsible for this global warming. But at the current rate of CO₂ emissions, developing countries would catch-up to and even begin to exceed developed countries in CO₂ emissions by 2035.

Table 6 shows the total of CO₂ emissions from fossil fuel use and cement manufacture for those countries listed in Annexure B of the Kyoto Protocol and for those countries not listed in Annexure B. In keeping with the convention of the IPCC methodology for calculating national GHG emissions, emissions from international bunker fuels (fuels used in international commerce) are not included in the country totals but are shown separately under the country group in which final fuel loading accrued. India is included in Non-Annex. B countries of the Kyoto Protocol. The table shows the Non-Annex. B countries, which are mostly developing countries, are fast catching up with the Annex. B countries, which are mostly, developed ones, in the field of CO₂ emissions.

Table 6 : Kyoto-Related Fossil-Fuel CO2 Emissions

	Annex B Countries		Non-Annex B Countries	
	Fossil –Fuel CO2 Emissions (Million metric tonnes C)	Bunkers (Million metric tonnes C)	Fossil-Fuel CO2 Emissions (Million metric tonnes C)	Bunkers (Million metric tonnes C)
1990	3865	86	2199	46
1991	3780	95	2396	41
1992	3677	103	2363	44
1993	3628	104	2424	47
1994	3610	103	2580	51
1995	3660	115	2655	56
1996	3704	115	2761	69
1997	3817	118	2834	71
1998	3821	123	2767	77
1999	3759	129	2832	85
2000	3821	135	2940	84
2001	3869	125	3037	85
2002	3845	129	3105	87
2003	3923	127	3364	91
2004	3982	138	3691	99

Source: Gregg Marland and Tom Boden (CDIAC, Oak Ridge National Laboratory).
www.cdiac.esd.ornl.in⁴

After Kyoto, the summit held at Bali, Indonesia in December 2007 saw some hard bargaining to launch a roadmap for a new agreement. This conference was aimed at launching two-year negotiations towards a new global warming agreement to take over from Kyoto, which is going to expire in 2012. Bali summit has set 2009 as deadline for new landmark pact to fight global warming. The UN IPCC stated in its landmark report in 2007 that annual worldwide emissions must be cut at least in half by 2050 to avoid the most serious consequences of global warming, such as severe sea-level rise and prolonged droughts. Some hard measures are also suggested in this Bali summit. US and China- the world's two biggest carbon polluters, each accounting for about 20 percent of the worldwide emissions- have opposed hard caps. Australia has decided to join the 1997 Kyoto Protocol at Bali, leaving the US as the only major industrialized country to reject the accord that requires rich nations to cut gas emissions by an average 5 percent.

The report of UNDP for the year 2007 was based on the theme “fighting climate change: human solidarity in divided world”. What it basically calls for is greater efforts in developing countries to ‘climate proof’ infrastructure,

deepening social protection for those most vulnerable building community resilience and strengthening disaster response. To fund these critical adaptation measures the report recommends \$86 billion be transferred from developed countries that bear the historical responsibility for climate change to developing countries between now and 2016.

How can we contribute to solve the issue of Global Warming at micro level

All the summits and conferences being organized on the issue have one common goal and that goal is 'how can we conserve our climate, our limited resources and our environment. Besides various steps being taken by the authorities, we, at our own level, have to contribute by moulding our life-style and making it more environment friendly. No matter how small our contribution is, it is hugely important. Some of the measures suggested are as follows:

1. Use efficient lighting: Replace incandescent bulbs with compact fluorescents (CFLs). These use four times less energy and last eight times longer.
2. Use energy efficient electric appliances: They use two to 10 times less electricity for the same functionality, and are mostly higher quality products that last longer than the less efficient ones. In short, efficient appliances save you lots of energy and money.
3. Use an energy efficient computer: Buy a laptop instead of a desktop. It consumes five times less electricity. If you buy a desktop, get an LCD screen.
4. Drive less: Walk, bike, carpool or take public transport. You will save 1.5 kg of carbon dioxide for every 5km you don't drive.
5. Check your tyres : Keeping your tyres inflated properly can improve the fuel efficiency of your car.
6. Use water carefully: Don't waste water. Use a mug of water when brushing your teeth, shaving or washing your hands and face. Instead of a shower or tub bath. Use a bucket. Try to harvest rainwater in your locality.
7. Say no to plastics: Take a cloth bag with you when shopping. Avoid products with a lot of packaging.
8. Move your Air-conditioning thermostat up 2 degrees C: Sunlight can be sued in many different ways to save energy. Use a solar water heater instead of an electric geyser. If you live in a village, you can use biogas form cow-dung to save energy.
9. Use renewable energy: Sunlight can be used in many different ways to save energy. Use a solar water heater instead of an electric geyser. If you live in a village, you can use biogas from cow-dung to save energy.

10. Plant more trees: A single tree will absorb one tonne of carbon dioxide over its lifetime.
11. Turn off electronic devices: Simply turning off your television, stereo, computer, fans, lights when you are not using them will save you thousands of kilograms of carbon dioxide a year.
12. Reuse and recycle: Recycling and re-using products like paper and bottles will help protect the environment. Use recycled paper.

Source: Sharma Vibha (2007)⁵

Apart from these, UN Academy of Sciences has recently suggested that if a large number of mirrors are set up into the space, these will obstruct the rays of the sun and will cause the rays to reschedule their path, which were coming directly onto the earth. This will help to reduce the temperature on the earth. Nobel laureate Dutch Chemist Paul Kouters believes that if rockets full of sulphur gas are launched into the environment, these will work as a 'cooling blanket' for the earth, which will help in reducing the temperature on the earth. All these steps, whether small or big, certainly make a difference.

A small town, 'Fazilka' in Punjab, has set up one prominent example of one small step. Fazilka has been selected first amongst all Asian cities for adopting best energy saving practices to fight against global warming in transportation. Located barely 11 kms from Indo-Pak border, the Graduate Welfare Association of Fazilka (GWAF), comprising well-placed people from this town, now serving in India and abroad, have launched a campaign which has been recognized by the World Carfree Network Community for setting up best examples to reduce the effect of global warming using religion.

As part of the campaign, residents of Fazilka organized the Fazilka Heritage Festival-2007 with the theme "global warming". Here the residents took a pledge to stop using plastic bags and use bicycles for short-distance travel. The town is consciously trying to maintain and use the 160-year old narrow residential street design by the East India Company. This has made Fazilka the safest town in India and perhaps in the world with no pedestrian and cyclist road crash death having been reported within the city zone. (Garewal Naveen S 2007)⁶

So, people now have realized that they can't depend on the Government alone for any help to improve their environment. They have to indulge in community participation programmes to cope up the very sensitive issue of Global Warming and climate change.

No doubt India has become one of the four major economies of the world. The fact that the economy is growing so fast leads one to think that in the times to come, every Indian is going to enjoy all the amenities of life. The technology has

reached the level of alternating a heap of audio cassettes and cds into a tiny ipod, the cumbersome books into a small pen drive and the bulky PCs into a small diary size laptop and that too, at nominal prices, of course for the people who can afford it. So this much advancement means growth and prosperity for the generations to come. But then, with so much progress all around, with so much technology all around, will there be any air to breathe in? Will there be any water to drink? Will there be any world worthy enough to live in?

The positive fact that we are developing cannot overpower the negative fact that we are taking with us, the basic resources of life leaving the coming generations with lots and lots of technology but, to be enjoyed in an environment full of fatal and deadly gases. The development that we have achieved in my view is in no way sustainable.

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